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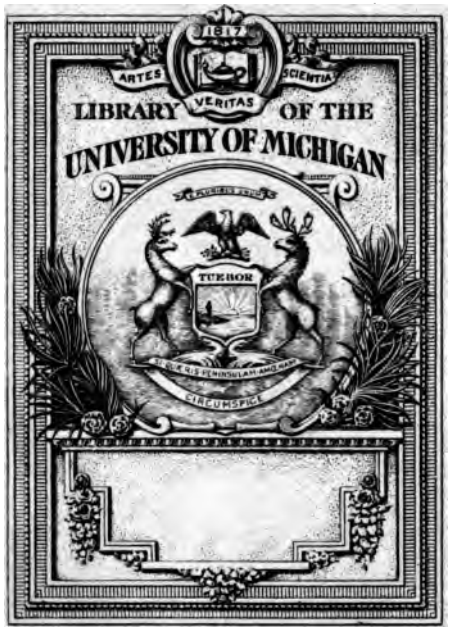
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OF

JOHN FISKE

WITH MANY PORTRAITS OF ILLUSTRIOUS PHILOSOPHERS, SCIENTISTS, AND OTHER MEN OF NOTE

IN TWELVE VOLUMES

VOLUME III

UNIV. OF MICH.

Sir Charles Lyell

OUTLINES OF COSMIC PHILOSOPHY

BASED ON THE DOCTRINE OF EVOLUTION, WITH CRITICISMS ON THE POSITIVE PHILOSOPHY

BY

JOHN FISKE

WITH AN INTRODUCTION BY JOSIAH ROYCE

L'univers, pour qui saurait l'embrasser d'un seul point de vue, ne serait, s'il est permis de le dire, qu'un fait unique et une grande vérité. — D'ALEMBERT

Καὶ τὸ ὅλον τοῦτο διὰ ταῦτα Κόσμον καλοῦσιν, οὐκ ἀκοσμίαν. — PLATO

IN FOUR VOLUMES. — VOLUME III.

BOSTON AND NEW YORK
HOUGHTON, MIFFLIN AND COMPANY
The Riverside Press, Cambridge
1902

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OUTLINES OF COSMIC PHILOSOPHY

PART II

SYNTHESIS (*continued*)

"Die Thätigkeit des Organismus ist bestimmt durch seine Receptivität und umgekehrt. Weder seine Thätigkeit noch seine Receptivität ist an sich etwas reelles, Realität erlangen beide nur in dieser Wechselbestimmung. Thätigkeit und Receptivität entstehen also zugleich in einem und demselben untheilbaren Moment, und nur dieses Simultaneität von Thätigkeit und Receptivität constituirt das Leben. In den entgegengesetzten Richtungen, die durch diese Entgegensetzung entstehen, liegt das Princip für die Construction aller Lebenserscheinungen."—SCHELLING, *Erster Entwurf*. 1799.

CHAPTER X

NATURAL SELECTION[1]

IN that most delightful of printed books, the "Conversations of Goethe with Eckermann and Soret," there is an amusing anecdote which shows how distinctly the great master realized the importance of the question of the origin of species. The news of the French Revolution of July, 1830, had just reached Weimar and set the whole town in commotion. In the course of the afternoon, says Soret, "I went around to Goethe's. 'Now,' exclaimed he to me, as I entered, 'what do you think of this great event? The volcano has come to an eruption; everything is in flames, and we have no longer a transaction with closed doors!' 'Terrible affair,' said I, 'but what could be expected under such outrageous circumstances, and with such a ministry, otherwise than that the whole would end with the expulsion of the royal family?' 'My good friend,' gravely returned Goethe, 'we seem not to understand each other.

[1] [See Introduction, § 18. Compare with this chapter the essay I. in *Darwinism and Other Essays*, on "Darwinism Verified."]

I am not speaking of those creatures there, but of something quite different. I am speaking of the contest, so important for science, between Cuvier and Geoffroy Saint-Hilaire, which has just come to an open rupture in the French Academy!'" At this unexpected turn of the subject poor Soret knew not what to say, and for some minutes, he tells us, his thoughts were quite at a standstill.

The anecdote well illustrates the immeasurable superiority of Goethe over Comte in prophetic insight into the bearings of the chief scientific question of the immediate future. While Comte was superciliously setting aside the problem of man's origin, as a problem not only insoluble but utterly devoid of philosophic value even if it could be solved, the great German poet and philosopher was welcoming the outbreak of this famous contest on questions of pure morphology, as conducive to the speedy triumph of the development theory, for which he himself had so long been waging battle. But events were hastening that triumph even more rapidly than Goethe could have anticipated. In December, 1831, only a few weeks before Goethe was laid in the grave, Mr. Darwin set out upon that voyage around the world, in the course of which he fell in with the facts which suggested his theory of the origin of species. The history of the investigation is a memorable one, — worth not-

ing for the illustration it gives of the habits of a truly scientific mind. On his return to England, in 1837, Mr. Darwin began patiently to collect all kinds of facts which might be of use in the solution of the problem, — "How is organic evolution caused?" It was only after seven years of unremitting labour that he went so far as to commit to manuscript a brief sketch of his general conclusions, of which the main points were communicated to his friends Sir Charles Lyell and Dr. Hooker. A less wise and sober speculator than Mr. Darwin would now at once have rushed into print. A thinker less thoroughly imbued with the true scientific spirit would probably have suffered from not publishing his views, and profiting by the adverse criticisms of contemporary observers. It is a striking illustration of Mr. Darwin's patience and self-restraint that he continued fifteen years longer to work assiduously in testing the weak and strong points of his theory, before presenting it to the public. And it is an equally interesting illustration of his thoroughly scientific temperament that, after so many years of solitary labour, he should have been so little carried away by the fascinations of his own hypothesis as to foresee clearly all the more valid objections which might be urged against it. After a careful perusal of the recent literature of the subject, and especially of the skilful work of Mr.

St. George Mivart, it still seems to me that the weightiest objections which have yet been brought to bear on the Darwinian theory are to be found in chapters vi.–ix. of Mr. Darwin's own work, where they are elaborately and in most cases conclusively answered. To such a marvellous instance of candour, patience, and sobriety, united with the utmost boldness of speculation, the history of science can show but few parallels.

In 1858 a fortunate circumstance caused Mr. Darwin to break his long silence, and to give to the public an exposition of the results of his researches. Mr. Wallace, who had been for several years engaged in studying the natural history of the Malay Archipelago, had arrived at views concerning the origin of species quite similar to Mr. Darwin's, and in 1858 he sent Mr. Darwin an essay on the subject, which in August of the same year was published in the Journal of the Linnæan Society. Sir Charles Lyell and Dr. Hooker now earnestly advised Mr. Darwin to publish his own views; and in 1859 the memorable treatise on the "Origin of Species" was given to the world.

It would, however, be incorrect to rate Mr. Wallace's merits, in the discovery of the law of natural selection, so high as Mr. Darwin's. They do not stand on precisely the same level, like Adams and Leverrier with reference to the

discovery of the planet Neptune. Mr. Wallace, indeed, thought out independently all the essential points of the theory, and stated it in a way which showed that he understood its wide-reaching importance; but being a much younger man than Mr. Darwin, and having begun the investigation at a much later date, he by no means worked it out so elaborately. Nor is it likely that, with an equal length of time at his command, he could have succeeded in producing a work comparable in scientific calibre to the "Origin of Species." His lately published collection of essays, while showing unusual powers of observation and rare acuteness in the application of his theory to certain special classes of phenomena, nevertheless furnishes convincing proof that in breadth and depth of scientific attainment, as well as in philosophic capacity, he is very far inferior to his great coadjutor. In his preface, indeed, Mr. Wallace hastens to acknowledge, with a modest self-appreciation as rare as it is admirable, and especially rare in such cases, that his strength would have been quite unequal to the task which Mr. Darwin has accomplished.

As Professor Haeckel somewhere observes, it was quite fortunate for the progress of science that Mr. Darwin received such a stimulus to the publication of his theory; since otherwise he might perhaps have gone on several years

longer, observing and experimenting in seclusion. The almost immediate acquiescence of the majority of naturalists in Mr. Darwin's views shows that in 1859 the scientific world was fully prepared for them. The flimsiness of the special creation hypothesis was more or less clearly perceived by a large number of biologists, who were only withheld from committing themselves to the derivation theory by the circumstance that no satisfactory explanation of the *process* of development had been propounded. No one had assigned an adequate cause for such a phenomenon as the gradual evolution of a new species; and sundry attempts which had been made in this direction were so obviously futile as to excite both distrust and ridicule. Lamarck, for example, placing an exaggerated stress upon an established law of biology, contended that "desires, by leading to increased actions of motor organs, may induce further development of such organs," and that, consequently, animals may become directly adapted through structural changes to changes in their environment. We shall see, as we continue the discussion, that such directly adaptive changes really take place; but Lamarck ill understood their character, and indeed could not have been expected to understand it, since in his day dynamical biology was in its earliest infancy.[1] By insisting on volition

[1] Lamarck also tried to explain organic development meta-

as a chief cause of adaptive change, the illustrious naturalist not only left the causes of vegetable variation unexplained, but even in the zoölogical department laid open the way for malicious misrepresentations which the uninstructed zeal of theological adversaries has gladly transferred to the account of Mr. Darwin. Some time ago a clergyman in New York, lecturing about Darwinism, sarcastically alluded to "the bear which took to swimming, and so became a whale." Had this worthy person condescended to study the subject about which he thought himself fit to enlighten the public, he would soon have discovered that his funny remark is not even a parody upon any opinion held by Mr. Darwin. In so far as it is applicable to any opinion ever held by a scientific writer, it may perhaps be accepted as a parody, though at best a very far-fetched and feeble one, of the hypothesis of Lamarck.

It is now time to explain what the Darwinian theory is. At the outset we may observe that while it is a common error to speak of Mr. Darwin as if he were the originator of the derivation theory, the opposite error is not unfrequently committed of alluding to him as if he had contributed nothing to the establishment of that theory save the doctrine of natural se-

physically, as the continuous manifestation of an "inherent tendency" toward perfection.

lection. Mr. Mivart habitually thus alludes to him. In fact, however, Mr. Darwin's merits are twofold. He was the first to marshal the arguments from classification, embryology, morphology, and distribution, and thus fairly to establish the fact that there has been a derivation of higher forms from lower; and he was also the first to point out the *modus operandi* of the change. The first of these achievements by itself would have entitled him to associate his name with the development theory; though it was only by the second that the triumph of the theory was practically assured. Just as, in astronomy, the heliocentric theory was not regarded as completely established until the forces which it postulated were explained as identical with forces already known, so the development theory possessed comparatively little value as a working hypothesis so long as it still remained doubtful whether there were any known or knowable causes sufficient to have brought about the phenomena which that theory assumed to have taken place. It was by pointing out adequate causes of organic evolution that Mr. Darwin established the development theory upon a thoroughly scientific basis.

As Lyell explained all past geologic phenomena as due to the slow action of the same forces which are still in action over the earth's surface and beneath its crust, so Mr. Darwin,

in explaining the evolution of higher from lower forms of life, appeals only to agencies which are still visibly in action. Whether species, in a state of nature, are changing or not at the present time, cannot be determined by direct observation, any more than the motion of the hour-hand of a clock could be detected by gazing at it for one second.[1] The entire period which has elapsed since men began to observe nature systematically is but an infinitesimal portion of the period requisite for any fundamental alteration in the characteristics of a species. But there are innumerable cases in which species are made to change rapidly through the deliberate intervention of man. In the course of a few thousand years, a great number of varieties of plants and animals have been produced under domestication, many of which

[1] "If we imagine mankind to be contemplated by some creature as short-lived as an ephemeron, but possessing intelligence like our own — if we imagine such a being studying men and women, during his few hours of life, and speculating as to the mode in which they came into existence; it is manifest that, reasoning in the usual way, he would suppose each man and woman to have been separately created. No appreciable changes of structure occurring during the few hours over which his observations extended, this being would probably infer that no changes of structure were taking place, or had taken place; and that from the outset, each man and woman had possessed all the characters then visible — had been originally formed with them. This would naturally be the first impression." Spencer, *Principles of Biology*, vol. i. p. 338.

differ so widely from their parent-forms that, if found in a state of nature, they would be unhesitatingly classified as distinct species, and sometimes as distinct genera. Modifications in the specific characters of domesticated organisms are the only ones which take place so rapidly that we can actually observe them; and it therefore becomes highly important to inquire what is the agency which produces these modifications.

That agency is neither more nor less than *selection*, taking advantage of that slight but universal variation in organisms implied by the fact that no two individuals in any species are exactly alike. If man, for example, wishes to produce a breed of fleet race-horses, he has only to take a score of horses and select from these the fleetest to pair together: from among the offspring of these fleet pairs he must again select the fleetest; and thus, in a few generations, he will obtain horses whose average speed far exceeds that of the fleetest of their undomesticated ancestors. It is in this and no other way that our breeds of race-horses have been produced. In this way too have been produced the fine wools of which our clothing is made. By selecting, generation after generation, the sheep with the finest and longest wool, a breed of sheep is ultimately reared with wool almost generically different from that of the undomes-

ticated race. In this and no other way have the different races of dogs — the greyhound, the mastiff, the terrier, the pointer, and the white-haired Eskimo — been artificially developed from two or three closely allied varieties of the wolf and jackal. The mastiff and bloodhound are more than ten times as large as the terrier, and, if found in a state of nature, they would perhaps be classed in distinct genera, like the leopard and panther, whose differences are hardly more striking. Yet the ancestral races from which these dogs have been reared differed but slightly from each other. The different breeds of dogs vary in the number of their toes, teeth, and vertebræ, in the number and disposition of their mammæ, in the shape of their zygomatic arches, and in the position of their occiputs; although dogs have not been selected with reference to these peculiarities, about which uninstructed men neither know nor care, but only with reference to their speed, fleetness, strength, or sagacity. In the case of domestic pigeons, where man has been to a great extent actuated by pure fancy in his selections, the divergences are still more remarkable. All domestic pigeons are descended from a single species of wild pigeon — yet their differences, even in bony structure, in the internal organs, and in mental disposition, are such as characterize distinct genera, and to describe them completely would

require a large volume. Pigs, rabbits, cows, fowl, silk-moths, and hive-bees furnish no less instructive evidence; and the development of the peach and the almond from a common stock, and of countless varieties of apple from the sour crab, may be cited, out of a hundred examples, to show what prodigies artificial selection has accomplished in the modification of vegetal organisms.

Now Mr. Darwin's great achievement has been to show that a similar process of selection, going on throughout the organic world without the knowledge or intervention of man, tends not only to maintain but to produce adaptive alterations in plants and animals. The process is a simple one, when once we have the clew to it. All plants and animals tend to increase in a high geometrical ratio. The old problem of the nails in the horse's shoe teaches us what an astounding affair is a geometrical rate of increase; but when we consider the reproductive capacity of insects and plants, the nails in the horse's shoe are left nowhere. When Arctic travellers tell us that the minute protococcus multiplies so fast as to colour blood-red many acres of snow in a single night, such a rate of increase appears astonishing. But it is a mere trifle compared to what would happen if reproduction were to go on unchecked. Let us take the case of a plant which yields one hundred

seeds yearly, and suppose each of these seeds to reach maturity so as to yield its hundred offspring in the following year: in the tenth year the product would be one hundred quintillions [1] of adult plants! As this is one of those figures before which the imagination stands hopelessly baffled, let us try the effect of an illustration. Supposing each of these plants to be from three to five inches in length, so that about twenty thousand would reach nearly an English mile, the total length of the number just mentioned would be equal to five million times the radius of the earth's orbit. The ray of light, which travels from the sun to the earth in eight minutes, would be seventy-six years in passing along this line of little plants! And in similar wise it might be shown of many insects, crustaceans, and fishes, that their unchecked reproduction could not long go on without requiring the assimilation of a greater quantity of matter than is contained in the whole solar system.

We may now begin dimly to realize how prodigious is the slaughter which unceasingly goes on throughout the organic world. For obviously, when a plant like the one just cited maintains year by year a tolerable uniformity in its numbers, it does so only because on the average ninety-nine seeds perish prematurely

[1] According to the American system of numeration. One hundred thousand trillions, according to the English system.

for one that survives long enough to produce other seeds. A single codfish has been known to lay six million eggs within a year. If these eggs were all to become adult codfishes, and the multiplication were to continue at this rate for three or four years, the ocean would not afford room for the species. Yet we have no reason to suppose that the race of codfishes is actually increasing in numbers to any notable extent. With the codfish, as with animal species in general, the numbers during many successive generations oscillate about a point which is fixed, or moves but slowly forward or backward. Instead of a geometrical increase with a ratio of six millions, there is practically no marked increase at all. Now this implies that out of the six million embryo codfish a sufficient number will survive to replace their two parents, and to replace a certain small proportion of those contemporary codfishes who leave no progeny. Perhaps a dozen may suffice for this, perhaps a hundred. The rest of the six million must die. We may thus understand what is meant by the "struggle for existence." Battles far more deadly than those of Gettysburg or Gravelotte have been incessantly waged on every square mile of the earth's life-bearing surface, since life first began. It is only thus that the enormous increase of each species has been kept within bounds. Of the many off-

spring produced by each plant and animal, save in the case of those highest in the scale, but few attain maturity and leave offspring behind them. The most perish for want of sustenance, or are slain to furnish food for other organisms. There is thus an unceasing struggle for life — a competition for the means of subsistence — going on among all plants and animals. In this struggle by far the greater number succumb without leaving offspring — but a few favoured ones in each generation survive and propagate to their offspring the qualities by virtue of which they have survived.

Thus we see what is meant by "Natural Selection." The organisms which survive and propagate their kind are those which are best adapted to the conditions in which they live; so that we may, by a legitimate use of metaphor, personify Nature as a mighty breeder, selecting from each generation those individuals which are fleetest, strongest, most sagacious: lions with supplest muscles, moths with longest antennæ, mollusks with hardest shells, wolves with keenest scent, bees with surest instinct, flowers with sweetest nectar; until, in the course of untold ages, the numberless varieties of organic life have been produced by the same process of which man now takes advantage in order to produce variations to suit his own caprices.

Between natural selection and selection by

man there is, however, one important difference. Selection by man tends to produce varieties adapted to satisfy human necessities or inclinations, and it has no direct reference to the maintenance of the species. Such abnormities as the pouter and tumbler pigeons could not be sustained in a state of nature — and hence, when domesticated animals are turned loose, they are apt to revert to something like their ancestral type,[1] else they are exterminated by races better adapted to wild life. But natural selection, working with the sternest of methods, saves from the general slaughter only those individuals which can best take care of themselves, and thus maintains each species in adaptation to its environment. The wonderful harmonies in the organic world, which a crude philosophy explained as the achievement of creative contrivance, are therefore due to the continued survival of the fittest and the continued slaughter of the less adapted plants and animals.

Now if the geography and meteorology of the earth were ever-constant, if the nature of the soil, the amount of moisture, the density of the atmosphere, and the intensity of solar radiance were everywhere to remain forever un-

[1] This fact, which has often been alleged by superficial critics as an obstacle to the Darwinian theory, is thus in reality implied by that theory.

altered, and if each race of plants and animals were always to remain confined to one limited area, the survival of the fittest would simply maintain unaltered any given aspect of the beings constituting the organic world. All variations on either side of the well-adjusted mean would be incessantly cut off by natural selection, and species would be immutable. It is needless to say that no such state of things has ever existed. Constant change has been the order of things ever since our planet first became fit to support organic life. No part of the earth's surface is now, or ever has been, at rest. Continents are rising and sinking, seas are growing deeper and shallower, soils are constantly altering in chemical composition, rivers are ever changing their beds, solar radiance is ever gaining or losing in intensity, according to the earth's ever-varying position in space, the density and moisture of the air are continually increasing and diminishing, and every species of plant and animal is continually pressing upon the limits of the area within which it is confined. All these changes are going on to-day, and have been going on during millions of ages. Though so slight as to be recognized only by the most careful observation during the period covered by human history, these changes have during longer periods sufficed to submerge every continent and perhaps to make dry land of every

sea and ocean on the face of the globe. They have raised mountains like the Andes and the Himalayas at the rate of a few inches per century; they have converted extensive tropical swamps into the desert of Sahara; they have repeatedly covered Europe and North America with glaciers; and they have hidden beneath solid rocks vast treasures of carbon stealthily purloined from the dense atmosphere of an older age.

Since such changes have ever been going on, it follows that organisms have been unable to remain constant and live. A race of animals or plants in which no individuals ever varied would sooner or later inevitably be exterminated, leaving no progeny to fill its place. Observation shows, however, that there is no such race. The members of each species are ever slightly varying, but, so long as the environment remains constant, natural selection prevents the variations from accumulating on either side of the mean which is most advantageous to the species. When the environment changes, if certain variations on one side of the established mean tend to bring the individuals which manifest them into closer adaptation to the new environment, these individuals will survive in the struggle for life, and thus the average character of the species will be slightly altered. No two bears have just the same amount of hair, no

two moths have just the same length of proboscis, no two antelopes are exactly matched in fleetness. Now if increasing cold renders a thicker covering useful to the bear, or if the lengthening of a flower-calyx, due to a slight change in soil or quantity of sunlight, renders a longer proboscis useful to the moth, or if the immigration of a carnivorous animal makes it necessary for antelopes often to run for their lives, then in each generation the thickest-coated bears, the longest-tongued moths, and the fleetest antelopes will survive. Every individual variation in the direction of a heavier coat, a longer sucker, or a structure better adapted for fleeing will give its owner the advantage in the incessant struggle for life, and these peculiarities will be oftenest inherited, while individuals which do not vary, or which vary in the wrong direction, will have to migrate or die.[1]

The student of natural history, who realizes, however dimly, the prodigious complexity of the relations of the various species of animals and plants to each other, will perceive that the amount of variation thus preserved and enhanced must in the course of long ages become

[1] It is thus one of the great merits of the theory of natural selection, that it accounts for the phenomena of *extinction* of species, — which formerly could only be accounted for by the gratuitous and utterly indefensible hypothesis of periodical catastrophes or cataclysms.

enormous. If a grain of sand were each year added to an ant-heap, it would in course of time become as large as Chimborazo. But these changes, directly caused by natural selection, are greatly aided and emphasized by other changes indirectly produced by correlation of growth, and also by what is called the law of use and disuse. By correlation of growth, or internal equilibration, we mean the effect produced upon any part of the organism by change in a related or neighbouring part. Let us suppose that it becomes advantageous to some feline animal, like the ancestor of the lion, to have large and powerful jaws. Since no two of our leonines would have jaws of exactly the same size and strength, natural selection would preserve all the strong-jawed individuals, while the weak-jawed individuals would succumb in the struggle for life. In the course of many generations our race of leonines would possess on the average much larger and stronger jaws than at the period at which we began to consider it. But greater weight of jaw entails increased exertion of the muscles which move the jaw, so that these muscles, receiving more and more blood, will become permanently increased in size and power. The portions of the skull into which the jaw bones fit will likewise receive an extra strain, and will consequently increase in rate of nutrition and grow to a larger size, so

that the shape of the whole head will be altered. This increased weight of the head, and the increasingly violent activity of the muscles which move the jaws, entails a greater strain upon the vertebræ which support the head, and upon the cervical muscles which move it from side to side. The heightened nutrition of these bones and muscles will add to their weight, so that the shoulders and chest will be affected. There will be a tightening of the tendons, and probably a perceptible alteration in the relative lengths of the different bones and muscles throughout the anterior part of the body; and these changes, altering the animal's centre of gravity, will inevitably cause other compensating changes in the rest of the body. The legs, shoulders, and haunches will be modified. Alterations in the weights bearing upon the chest will affect the growth of the lungs and the aeration of the blood. And the stomach, intestines, and various secreting glands will respond to the requirements of all these nutritive changes. While, lastly, such deep-seated variations cannot fail to influence the nervous system of the animal, and to modify somewhat its temperament and its modes of life.

To illustrate the effects of use and disuse, let us reconsider the antelopes, of whom natural selection has so long preserved the swiftest and most quickly frightened individuals that they

now rank among the fleetest and most timid of mammals. If all the lions and other swift carnivora of Africa were to become extinct, so that antelopes would no longer have to run for their lives, the slower and less easily alarmed individuals would begin to be preserved in as great numbers as the swifter and more timid ones, so that by and by the average speed and timidity of the race would be diminished. In all this we see merely the effects wrought by unaided natural selection. But it is a fundamental law of biology that functions are maintained at their maximum only through constant exercise. Freed from savage enemies, our antelopes would less frequently use the muscles concerned in running, and would less often exercise the mental faculties concerned in the rapid perception of approaching danger. Inevitably, therefore, they would, after several generations, diminish in speed, and become less alert and less timid. Here we see the effects of what is called the law of use and disuse. But to these we should also have to add the effects of correlation of growth. Decrease in speed involving decrease in muscular tonicity, and rendering possible the assimilation of less concentrated food, would seriously modify the nutrition of the entire organism. The digestive tract would probably be enlarged, and larger and lazier bodies could not fail to be produced, both by the direct in-

fluence of the nutritive processes, and because natural selection would no longer necessitate the slaughter of all clumsy bodied individuals. Thus in course of time the breed of antelopes would become so thoroughly altered as to constitute a distinct species from their graceful, swift, and timid ancestors. It is in just these ways that New Zealand birds, freed by insular isolation from the attacks of mammalian enemies, have grown large and clumsy, and have lost the power of flight which their partly aborted wings show that they once possessed.

By the same kind of illustration we may form a rough notion of the way in which a single species bifurcates into two well-defined species. Suppose a race of ruminants to have been living in Africa before the introduction of carnivora, and suppose that, for sundry reasons, the vitality of the race was but little affected by moderate variations in the sizes of its individuals, so that while some were comparatively light and nimble, others were comparatively large and clumsy. Now introducing upon the scene the common ancestor of the lion and the leopard — by immigration either from Asia or from some other adjacent territory now submerged — let us note some probable features of the complex result. First, as regards the attacked ruminants, it is likely that in course of time the lightest and swiftest individuals,

habitually taking refuge in flight, would have greatly increased both in fleetness and in timidity; the largest and most clumsy of the species, unable to save themselves by fleeing, would often be forced to stand and fight for their lives, and would thus ultimately have gained in size, strength, and courage; while those who were neither nimble enough to get out of the way nor strong enough to fight successfully would have all been killed off. And thus, after a while, by perpetual destruction of the means and preservation of the extremes, we should get two kinds of ruminant as different from one another as the antelope which escapes by his fleetness and cautious timidity, and the buffalo which boldly withstands the lion and not unfrequently conquers or repulses him. Secondly, let us observe what must have been going on all the while with the attacking carnivora. The lighter and less powerful of these would find manifest advantage in crouching amid dense foliage and springing down upon unwary victims passing below. The larger and more powerful individuals would more frequently roam about the open country, attacking the larger ruminants and giving chase to the nimbler ones, and would thus increase in strength and fleetness. And thus there would be initiated such differences of size and habit as characterize the leopard and the lion.

It must be borne in mind that this is a purely hypothetical illustration, which does not pretend to give a complete account of the complex process. I have no idea that the differentiation between antelopes and buffaloes, or between lions and leopards, was accomplished in any such straightforward way as this. But while unduly simplifying the case, the illustration is undoubtedly sound in principle. No doubt the lion is so strong and so swift because only the strongest and swiftest lions have been able to prey at once upon buffaloes and upon antelopes. No doubt the antelope is so swift and so timid because only the swiftest and most quickly frightened antelopes have been enabled to get away from the lion, and to propagate their kind. And no doubt in the process above described, we get a partial glimpse of some of the essential incidents in the past careers of these races.

All the foregoing illustrations unite in enforcing the conclusion that the direct and indirect effects of natural selection are by no means limited to slight or superficial changes in organisms. The student of physiology well knows that no change, however seemingly trivial, which ensures the survival of the organism in its fierce struggle for existence, can fail in the long run to entail so many other changes as to modify, more or less perceptibly, the entire structure.

Even such a slight change as an increased thickness of the woolly coat of a mammal may, by altering the excretory power of the skin, affect the functions of the lungs, liver, and kidneys, and thus indirectly increase or diminish the size of the animal, which in turn will modify its speed, its muscular development, its mental faculties, and its habits of life.

Having thus briefly indicated the capacity of the theory of natural selection for explaining the most general phenomena of organic variation, let us in conclusion observe how admirably it explains certain special phenomena, which do not otherwise admit of scientific explanation. For evidence of the signal success with which Mr. Darwin has explained such otherwise unaccountable facts as the dimorphism of certain flowers, the existence of neuters or sterile females among bees and ants, the odoriferous glands in mammals, the calcareous shells of mollusks, the heavy carapace of the tortoise, the humps of the camel, the amazingly complicated contrivances through which orchidaceous plants are fertilized by insects, the slave-making instinct of certain ants, the horns of male ruminants, and countless other phenomena, — for all this, I must refer to Mr. Darwin's various works. From the mass of phenomena to which the theory of natural selection has been satisfactorily applied, I will only select as an illustra-

tion the case of colour, in the animal and vegetal kingdoms.

Until after the publication of Mr. Darwin's speculations, the colours of plants and animals had never been made the subject of careful and philosophical study. So far as any hypothesis was held concerning these phenomena, it was the vaguely conceived hypothesis that they are due to the direct action of such physical conditions as climate, soil, or food. But there are fatal objections to such an explanation. When Dr. Forbes Winslow, in his work on the "Physiological Influence of Light," tells us that "the white colour of animals inhabiting the polar regions is attributable to the absence of intense sunlight," it is an obvious objection that the polar regions are not preëminent for darkness. Though within the limits of the arctic circle the sun is below the horizon for six months together, it is none the less for the other six months above the horizon; and though its slanting rays do not cause excessive heat in the summer, the prolonged glare of light, intensified by reflection from the snow and ice, is described as peculiarly intolerable. The summer ought to tan the polar bears as much as the winter can bleach them. And to this it may be added that the Eskimos and Greenlanders, living under the polar circle, are not bleached. Several other facts, alike incompatible with the direct action

of physical agencies, are mentioned by Mr. Wallace. While wild rabbits, for instance, are always tinted gray or brown, the same rabbits, when domesticated, give birth to white and black varieties, though there has been no change either in climate or in food. The case is the same with domestic pigeons. But even supposing that the most general features of animal colouring could be explained on this hypothesis,— which they cannot be, — there would still remain the more remarkable cases of tree-frogs, which resemble bark, and of the so-called leaf-butterflies, which when at rest are indistinguishable from leaves; and the existence of such cases is a stumbling-block in the way of all theories save the theory of natural selection.

For according to the theory of natural selection each species of animals will be characterized by that shade of colour which is most advantageous to the species in the struggle for existence. Now, as Mr. Wallace observes, "concealment is useful to many animals, and absolutely essential to some. Those which have numerous enemies from which they cannot escape by rapidity of motion, find safety in concealment. Those which prey upon others must also be so constituted as not to alarm them by their presence or their approach, or they would soon die of hunger." In striking harmony with this general principle, we find that the great

majority of animals are so coloured as best to escape notice, and that animals which are not protectively coloured are animals whose habits of life are such as to enable them to dispense with secrecy. The polar bear is white, as the California bear is gray and the Hindustan bear black, because with a coat thus coloured it can best escape notice and secure its prey. The polar hare has a permanent coat of white; but the alpine hare, the arctic fox, and the ermine, which do not live amid perpetual snow, have coats that are white in the winter only. Arctic owls, falcons, and buntings are coloured snowy white; and the ptarmigan is white in winter, while "its summer plumage so exactly harmonizes with the lichen-covered stones among which it delights to sit, that a person may walk through a flock of them without seeing a single bird." In the sandy deserts of Northern Africa, all birds, without exception, all snakes and lizards, and all the smaller mammals, are of a uniform sandy colour. The camel is tinted like the desert in which he lives, and the same is true of the antelope and the Australian kangaroo. The tawny lion, says Mr. Wallace, "is a typical example of this, and must be almost invisible when crouched upon the sand or among desert rocks and stones." His brother, the tiger, "is a jungle animal, and hides himself among tufts of grass or of bamboos, and in these

positions the vertical stripes with which his body is adorned must so assimilate with the vertical stems of the bamboo as to assist greatly in concealing him from his approaching prey. How remarkable it is that besides the lion and tiger, almost all the other large cats are arboreal in their habits, and almost all have ocellated or spotted skins, which must certainly tend to blend them with the background of foliage — while the one exception, the puma, has an ashy brown uniform fur, and has the habit of clinging so closely to a limb of a tree, while waiting for his prey to pass beneath, as to be hardly distinguishable from the bark." [1] Such nocturnal animals as owls, goat-suckers, mice, bats, and moles are dusky coloured. In tropical forests, where the trees are laden with green foliage all the year round, we find brilliant green pigeons and parrots; while the northern snipe resembles the marshy vegetation in which it lives, and the woodcock, with its variegated browns and yellows, is inconspicuous among the autumn leaves.[2] Arboreal iguanas are tinted leafy green; and out of many species of tropical tree-snakes

[1] Wallace, *Natural Selection*, pp. 49, 53.

[2] The general principle is well stated by Emerson, in this pretty quatrain: —

> "He took the colour of his vest
> From rabbit's coat and grouse's breast;
> For as the wild kinds lurk and hide,
> So walks the huntsman unespied."

there is but one which is not green, and this kind conceals itself during the daytime in holes. Flat fish, like the skate and flounder, are coloured like the gravel beneath them. Fishes which live among gorgeous coral reefs are magnificently tinted. The brilliant red hippocampi of Australia dwell among seaweed of the same colour. And numerous other examples from the vertebrate sub-kingdom are given by Mr. Wallace, from whose remarkable essay the examples here given are culled.

Before going farther, let us note how completely these interesting phenomena are in harmony with the theory of natural selection. The variability of the hues of domestic animals descended from a monotonously coloured wild species shows that there is no direct physiological necessity for the production of animals of a single given style of colouring. But it is tolerably obvious that in the struggle for existence the most conspicuous among those animals which serve as food for others will be the soonest detected, killed, and eaten; while in general the most conspicuous carnivorous animals will be the most easily avoided, and hence will be the most likely to perish for lack of sustenance. And while it is not universally true of the higher animals, as it is of the lower animals and plants, that a much greater number perish than survive, the destruction of life is nevertheless

so great that the fate of each creature must often depend upon apparently trivial circumstances. The explanation would therefore be satisfactory, even if protective shades of colouring could be regarded as circumstances of slight importance, — which they cannot.

Since, therefore, it is natural selection which keeps up the protective hues of animals, by killing off all save the least conspicuous individuals, we may understand why it is that animals which have for several generations been domesticated no longer retain, without considerable deviation, their protective style of colouring. Freed from the exigencies of wild life, there is no longer an imperious need for concealment, and hence the unfavourably coloured individuals survive like the rest, and variety appears among members of the same species. In the cat family, which appears to have been originally arboreal, there is a strong tendency to the production of stripes and spots. In the lion, which is not arboreal, and in the puma, owing to the peculiarity above mentioned, these variegated markings have been almost wholly weeded out by natural selection.[1] But in the domestic cat, along with these spots and stripes

[1] The variegated marking usually appears, however, in lion-cubs ; thus showing that the variegated colouring of the leopard and tiger is relatively primary, while the monotonous colouring of the adult lion is relatively secondary.

which occasionally show its blood-relationship with the leopard and tiger, we more often meet with colours not paralleled among the wild species; now and then we see cats which are coal-black or snowy white. Cows, horses, sheep, dogs, and fowl furnish parallel examples. Thus too we may understand why the sable and the Canadian woodchuck retain their brown fur during the winter; for the one can subsist on berries, and is far more agile than any of its foes, while the other lives in burrows by the river-side and catches small fish that swim by in the water. And thus we may understand why it is that in the case of birds which build open nests, the female is dull coloured like the nest; while on the other hand, the females of birds which build domed nests are often as brightly coloured as the males.

Turning now to the insect world, we find a vast abundance of corroborative proof. Among the tiger-beetles examined by Mr. Wallace in the Malay islands, those which lived upon wet mossy stones in mountain brooks were coloured velvet green; others, found for the most part on dead leaves in the forest, were brown; others again, "never seen except on the wet mud of salt marshes, were of a glossy olive so exactly the colour of the mud as only to be distinguished when the sun shone," by casting a shadow. "In the tropics there are thousands of species

of insects which rest during the day clinging to the bark of dead or fallen trees; and the greater portion of these are delicately mottled with gray and brown tints, which though symmetrically disposed and infinitely varied, yet blend so completely with the usual colours of the bark, that at two or three feet distance they are quite indistinguishable." Moths, which when resting expose the upper surfaces of their wings, have these dull coloured. Butterflies, on the other hand, which rest with their wings raised perpendicularly and laid together so as to show only the under surfaces, have the upper surfaces brilliantly coloured, while the exposed under surfaces are dusky and inconspicuous — or even marked in imitation of leaves. Mr. Wallace describes an East Indian butterfly whose wings are superbly tinted with blue and orange: this butterfly is a very swift flyer and is never known to settle save among the dead leaves in the dry forests which it frequents. When settled, with its wings raised, it imitates a shrivelled leaf so perfectly that even the keen eye of the naturalist can hardly detect it. This protective colouring is found throughout the whole immense order to which belong grasshoppers, crickets, and locusts; the most remarkable instance being furnished by the so-called "walking-leaf," to which no description can do justice. On the other hand, hornets, bees, and wasps, which are

protected by their stings, are brilliantly but not in general protectively coloured. Bugs and ground-beetles emit a disagreeable, pungent smell, and they are often conspicuously coloured. But the most wonderful of all are the cases of protective mimicry. The heliconidæ are among the most beautiful of South American butterflies. Being never eaten by birds, on account of a nauseous liquid which exudes from them when touched, they are not only very lazy flyers, but have the under sides of their wings as gorgeously tinted as the upper side, so that they can be seen from quite a long distance. From the same cause they are prodigiously numerous, swarming in all the tropical forests. Now it is obvious that if another butterfly, not protected by a disagreeable odour or taste, were to resemble the heliconia in colouring, it would be as efficiently protected as by imitating a dead leaf or dry twig; provided that there were but few of these butterflies among a large number of heliconias. For, as Mr. Wallace says, "if the birds could not distinguish the two kinds externally, and there were on the average only one eatable among fifty uneatable, they would soon give up seeking for the eatable ones, even if they knew them to exist." Now along with the heliconidæ there does, in fact, live a distinct family of butterflies, the pieridæ, most of which are white, and which are anatomically as distinct

from the heliconidæ as a lion from a buffalo. But of these pieridæ there is one genus, the leptalis, which exactly resembles the heliconias in external appearance. So close is the resemblance that such expert naturalists as Mr. Bates and Mr. Wallace have been repeatedly deceived by it at the time of capture. Moreover, each species of this genus leptalis is a copy of the particular species of heliconia which lives in the same district. Every band and spot and fleck of colour in the heliconia is accurately reproduced in the leptalis; and besides this, the lazy mode of flight is also imitated; while in point of numbers, we find about one leptalis to a thousand heliconias. Nor is this the only instance. So preëminently favoured are these beautiful insects by their disgusting taste, that they are exactly imitated by at least three genera of diurnal moths. In other parts of the world similar phenomena have been noticed. The relationship of the leptalis to the heliconia is repeated in India, in the Philippine Islands, in the Malay archipelago, and in various parts of Africa; the protected insect being, in all these cases, very much less numerous than the insect whose colours it mimics. In similar wise, bees and wasps are often imitated by beetles, by flies, and even by moths.

For further details I must refer to Mr. Wallace's essay, which is a singularly beautiful

specimen of inductive reasoning. The facts already cited are quite enough to sustain the general conclusion that the colours of animals are in the main determined by the exigencies of the struggle for existence. Where it is for the advantage of an animal to be concealed, as in the great majority of cases, its colour, whether brilliant or sombre, is such as to protect it. But where the animal is otherwise adequately protected, — either by its peculiar habits, by a sting, a disgusting odour or taste, or a hard carapace, — and where it is not needful for it to be hidden from the prey upon which it feeds, then there is usually no reference to protection in the colour of the animal. In some of these cases, however, a very conspicuous colouring becomes protective — as in the case of the jet-black toad which Mr. Darwin saw in La Plata, which emitted a poisonous secretion, and which, when crawling over the sandy plain, could not fail to be recognized by every passing creature as an object to be avoided.

In many cases the gorgeous tints of the otherwise protected male animal are due to what is called "sexual selection," — to the continual selection of the more beautiful males by the females. To this cause is due the magnificent plumage of the male bird of paradise; and Mr. Darwin would similarly explain the brilliant colours of many male butterflies. In

his work on the "Descent of Man" may be found an account of the elaborate observations which have led to these conclusions. Without feeling it necessary to insist upon the validity of all the special explanations contained in that work, we must admit that the general theory is substantiated by a superabundance of inductive evidence. And when this kind of selection is taken in connection with the need for protective concealment, we have the means of explaining by far the greater part of the colouring found in the animal kingdom.

The colours of the vegetal kingdom have, to a considerable extent, been no less satisfactorily explained. "Flowers do not often need protection, but very often require the aid of insects to fertilize them, and maintain their reproductive powers in the greatest vigour. Their gay colours attract insects, as do also their sweet odours and honeyed secretions; and that this is the main function of colour in flowers is shown by the striking fact that those plants which can be perfectly fertilized by the wind, and do not need the aid of insects, rarely or never have gaily coloured flowers."[1]

Returning for one moment to the case of animals, which are usually benefited by concealment but sometimes by conspicuousness, let us note Professor Shaler's ingenious explanation

[1] Wallace, *Natural Selection*, p. 262.

of the rattlesnake's rattle. The existence of this appendage has long been a puzzle to philosophical naturalists, and Darwinians have been repeatedly challenged to account for the formation or preservation by natural selection of an organ assumed to be injurious to the species. The difficulty has lain in the assumption, too hastily made, that the noise or the rattle must be prejudicial to the snake by forewarning its enemies or prey of its presence, and thus giving the enemies time for sudden attack, and allowing the prey to escape. On the theory of natural selection, the preservation of the species must entail the atrophy of such an organ, or, rather, must prevent its origination, unless the damage occasioned by it be more than compensated by some utility not hitherto detected. Professor Shaler's hypothesis, however, suggests the possibility that this whole speculation is fundamentally erroneous. Far from being injurious to the snake, by serving to warn its prey, it would appear that the rattle may be directly useful by serving as a decoy. Professor Shaler has observed that the peculiar sound of the rattle is a very close imitation of the note emitted by a certain cicada common in American forests frequented by rattlesnakes; and according to his ingenious suggestion, the bird, hearing the note and thinking to make a meal of the cicada, advances upon its own destruc-

tion, becoming the eaten instead of the eater. If this be true, there may be data here for explaining some of the alleged phenomena of fascination, so far as rattlesnakes are concerned; and another case will be added to the numerous cases now on record in which certain animals have acquired, for utility's sake, peculiarities characteristic of totally different species. I should be more inclined, however, to adopt quite a different interpretation of the rattlesnake's rattle. As hinted above, the general law that animals are benefited by concealment has some important exceptions. In many cases, when an animal is especially noxious, it is for his advantage to be conspicuous, that enemies may recognize him at a distance and keep away from him. Thus, as we have seen, while grasshoppers, moths, and butterflies (on the exposed under-surfaces of their wings) are usually so coloured as best to escape notice, on the other hand, bees and wasps, which are protected by their stings, and many beetles, which are protected by a noxious taste or odour, are apt to be conspicuously coloured. And the jet-black toad of La Plata is a still better example. Now a rattlesnake is unquestionably a very noxious animal, and so dangerous to its enemies that they will always do well to keep out of its way. Moreover the death wound inflicted by it, though usually very sure, is some-

what slow in operation; so that in a fierce struggle it will often happen that its action is not prompt enough to preclude a return of compliments fatal to the snake. When a tiger tears open the jugular vein of his enemy, the enemy is placed *hors de combat* at once; but when the rattlesnake has bitten, there is nothing to prevent the foe from employing his few remaining moments in tearing the serpent to pieces. Hence the rattlesnake must be peculiarly benefited by an apparatus which serves as a signal to warn enemies of his presence, and to keep them from attacking him. His more formidable enemies, belonging chiefly to the mammalian class, are certainly intelligent enough to profit by such warning and shun the danger; and as it is plainly for the snake's advantage to avoid even a conflict, it is clear that he is practically helped even less by his terrible bite than by his power of threatening a bite.

This explanation seems to me quite sound in principle. Yet if we adopt it, there is nothing to prevent us from giving due weight also to Professor Shaler's suggestion. The success with which the note of the cicada is counterfeited by the rattle is a point to be more fully determined by further observation. And if it turns out that the rattle fulfils the double purpose of alarming sundry animals that are hostile and of enticing sundry others that are good

for food, it will not be the first case in which it has happened that a structure useful in one way has also become useful in another way. The question is an interesting one, and valuable if only because it reminds us of the danger of reasoning too confidently, from *a priori* premises, about matters the due elucidation of which requires careful study of the details of the every-day life of animals. It is one of the great merits of the theory of natural selection that it has directed so many naturalists, with eyes open, into this fruitful field of inquiry.

It is because it so well illustrates the wealth of suggestiveness in Mr. Darwin's theory, that I have ventured upon this digression. To the general validity of that theory, or even to the validity of the more special hypothesis concerning the uses of concealment or of conspicuousness, the success of the foregoing explanation is not essential, — since its possible inadequacy may very well be due to the incompleteness of our grasp upon all the details of this particular case. But, returning from this digression to our main thesis, and considering the general significance of the phenomena of colour, we see that, in addition to those most general phenomena of organic life which demand for their explanation the Darwinian theory, there is at least one special class of phenomena which that theory is competent to explain even in minute details.

And there are other special classes of phenomena to which it has been applied with equally remarkable success. But when a theory, deduced from the observed general facts of organic life, and invoking no agencies but such as are known to be in operation, is found on trial to account for such an enormous mass of special facts, for which no other valid explanation has been propounded, — we may well say of it, as Laplace said of his own Nebular Hypothesis, that the chances in favour of its being a true explanation are many thousand million to one.

CHAPTER XI

TWO OBJECTIONS CONSIDERED

WHEN an objection to a complex theory in any department of science is so extremely obvious as to seem at first sight fatal to the theory, it is unwise to urge it in argument until we have very thoroughly considered the matter. Men like Laplace and Goethe, Spencer and Darwin, in framing their theories of evolution, are indeed liable to overlook difficulties which are so unobtrusive as to be detected only after prolonged observation; but they are very unlikely to overlook difficulties which are so conspicuous as to occur at once to the minds of a hundred general readers. When, therefore, a reader of average culture, who has perhaps never seriously bent his mind to the question of the origin of species, and who is very likely unacquainted with the sciences which throw light upon that subject, finds himself immediately confronted by difficulties in a theory which men of the highest learning and capacity have spent a quarter of a century in testing, common prudence should lead him to continue his study until he has made sure that

the difficulty is not due to his own ignorance rather than to the shortcomings of the theory. This wholesome caution is too seldom manifested by literary reviewers, many of whom, in criticising Mr. Darwin's theory without having duly read his works, allege certain objections as being quite obvious to all intelligent people, save to the one-sided speculator who is supposed to have ignored them. In Mr. Darwin's case, this mode of treatment is peculiarly impertinent, since even the less obvious objections to the theory of natural selection were for the most part foreseen and answered in the first edition of the "Origin of Species," — a book to which, as to an arsenal of scientific facts, one must still resort who would deal intelligently with the latest criticisms directed against the theory.

The most obvious objection to the Darwinian theory is the paucity, or, as it is often incorrectly alleged, the absence, of transitional forms in the various sedimentary strata. This is at first sight a weighty objection against the doctrine of natural selection, according to which the progress has been effected by infinitesimal increments; although it is of no force against the doctrine of derivation, as held by Mr. Mivart, who rejects the maxim *Natura non facit saltum*, and maintains that progress has been effected by sudden jumps, occurring at rhythmical intervals. Mr. Mivart's suggestion, however, cannot be en-

tertained as a scientific hypothesis so long as it alleges no physical agencies competent to effect the sudden jumps from one specific form to another; nor does the comparative paucity of transitional forms in a fossil state afford any reason for our adopting it. A brief consideration will show us that the fact is entirely consistent with the theory of progress by minute variations.

In the first place, let us note that in general intermediate transitional forms must be the soonest killed off in the struggle for existence; and that, especially, where two strains or varieties become further differentiated into true species, it is the extreme forms which multiply at the expense of those which are intercalated between them. Here, as on a former occasion, our comprehension of the argument will be facilitated by a reference to the analogous set of phenomena which occur during the process of linguistic differentiation. It is held by most philologists that all languages in the tertiary or amalgamative stage of development must have previously existed in the secondary or agglutinative stage, — and, at a yet earlier period, in the primary or juxtapositive stage, of which the Chinese is a still living example. Against this view M. Renan has urged the absence or paucity of transitional forms connecting one class of languages with another. Now in answering

M. Renan's objection, I have begun by showing, from a consideration of the Romanic dialects, that the difficulty is only imaginary. "A language like Latin, spread over a vast space of country in imperfectly civilized times, inevitably breaks up into a host of local *patois*. Each secluded rustic community has its own style of pronunciation, its own choice of words and syntactical devices, its own method of contracting or otherwise modifying its expressions. And although the inhabitants of any given town can usually communicate with those of the next town, the slight differences accumulate until intercourse between distant places is no longer practicable. In such a state of things we find plenty of transitional dialects, as the Genoese and Provençal between Italian and French, and the Balearic and Catalan between French and Spanish. The Tuscan can understand the Genoese, the Genoese can understand the dweller in Piedmont, the Piedmontese can understand the Vaudois, the Vaudois can understand the Lyonnais, and so on until we come to Paris; but the Tuscan and the Parisian cannot understand each other. Now the progress of civilization in each country tends to kill out the *patois*, elevating that variety of the language which has been made the vehicle of the dominant literature to supremacy over the more provincial forms. Increased facilities of com-

munication, and the growth of large centres of population, and commercial as well as literary activity, end by making the inhabitants of all parts of the country speak and write more and more like those of its intellectual metropolis. And in this way the intermediate dialects slowly disappear, leaving two languages with thoroughly distinct individualities, like Italian and French."[1] Now even here, as I go on to show, the relationships among the dialects have become sufficiently obscured — owing to disappearance of connecting links — to allow M. Raynouard to maintain the paradox that the modern Romanic languages are descended, not directly from the Latin, but from the old Provençal. And in such countries as Hindustan, the processes of divergence, and accompanying obliteration, have gone on to such an extent that Bengali has been mistaken for a non-Aryan language.

Here in the domain of language we see that competition is most severe and destructive between closely allied forms, and that the extremes will vigorously flourish long after the short-lived means have been crushed out of existence. The maxim *In medio tutissimus ibis* does not apply to such cases. We have now to observe that among the phenomena which natural his-

[1] "The Genesis of Language," *North American Review*, October, 1869, pp. 334, 335.

tory deals with, a quite similar process goes on. First we may note, with Mr. Darwin, that "as the species of the same genus usually have, though by no means invariably, much similarity in habits and constitution, and always in structure, the struggle will generally be more severe between them, if they come into competition with each other, than between the species of distinct genera. We see this in the recent extension over parts of the United States of one species of swallow having caused the decrease of another species. The recent increase of the missel-thrush in parts of Scotland has caused the decrease of the song-thrush. How frequently we hear of one species of rat taking the place of another species under the most different climates! In Russia the small Asiatic cockroach has everywhere driven before it its great congener. In Australia the imported hive-bee is rapidly exterminating the small stingless native bee. One species of charlock has been known to supplant another species; and so in other cases. We can dimly see why the competition should be most severe between allied forms, which fill nearly the same place in the economy of nature; but probably in no one case could we precisely say why one species has been victorious over another in the great battle of life."[1]

[1] *Origin of Species*, 6th edition, p. 59.

For our present purpose, however, it is not needful that we should be able to accomplish the latter task, which would require a knowledge of the minutiæ of the organic world such as is not likely to be possessed by any one for a long time to come. It is enough for us to note that the ordinary process of competition, among organisms as among dialects, tends to kill out the means much sooner than the extremes. Still more clear will this become, if we recur to one of the hypothetical illustrations given in the preceding chapter. It was there shown that, in the case of a group of ruminants hitherto isolated from carnivorous foes, and in which different strains or varieties have begun to establish themselves, a newly arriving incident force, in the shape of strong and swift carnivora, will at once tend to exterminate all the intermediate forms, while the extremes will not only be indefinitely preserved, but will become yet more widely different from each other. Now this hypothetical case is probably a fair sample of a very large proportion — perhaps the majority — of the cases in which specific variations have been rapidly accumulated and persistently fixed. It is by no means likely that variation has gone on throughout the past with a uniform pace; but there must rather have been immensely long periods of comparative stability, alternating with relatively brief periods,

during which newly introduced sets of circumstances have tended to enhance and accumulate variations on either side of a hitherto established mean. Such a conclusion is implied by the theory of natural selection, according to which specific variation occurs, not in conformity to some mysterious law of progress uniformly operating, but only in conformity to some more or less conspicuous alteration in the sum total of the conditions of existence.

It follows, therefore, that in general, when incipient varieties are differentiated into well-marked species, the number of intermediate forms must be immeasurably smaller than the numbers of forms contained in the resulting species to which they serve as the transition. During epochs of rapid divergence, the means may all be extinguished after a few hundred generations, while the generations of the extremes which persist thereafter may be numbered by tens of thousands. Suppose, for example, two great islands separated by a shallow sea. During long ages, while the floor of this intervening sea is constantly rising, the specific changes occurring on either island may be quite few and unimportant, and such fossil records as are left will indicate a general persistence of type. But when in course of time the process of elevation has converted this intervening channel into an isthmus connecting the two

islands, there must inevitably ensue a marked change in the conditions of existence in both regions. Extinction will go on at a relatively rapid pace; and, as above illustrated, this extinction must ordinarily result in the disappearance of intermediate forms and the preservation of extremes. After a while this process must result in the establishment of an approximate equilibrium among the forms of life over both areas, such as formerly obtained over each area separately. And thus for a long time to come, the specific changes occurring will again be few and unimportant.

Thus we see graphically illustrated the truth that, in comparison with the myriads of individuals comprising the well-defined species which propagate themselves through long ages with relative stability of character, the number of intermediate individuals which ever come into existence must be relatively small. We have next to note that, even of this relatively small number of individuals, a still smaller relative number are likely to leave after death a permanent fossil record of their existence.

In the first place it is only by a rare combination of circumstances that any plant or animal gets fossilized at all. The chances were nearly infinite against the preservation of any of the very earliest organisms, with their soft and speedily decaying textures. The higher

land animals, on the other hand, owe their occasional preservation to the accidents of dying in sheltered caves, or of being covered with blown sand or peat-moss, or of being frozen in Arctic ice. Trees with solid trunks, littoral and marine animals, especially crustaceans and shell-covered mollusks, are more likely to be preserved than other organisms. But in the second place, the majority of the organisms once fossilized are afterwards destroyed along with the sedimentary strata which contain them. Since there have been several enormously long alternating periods of elevation and of subsidence, it follows that all the older sedimentary strata must have been metamorphosed by volcanic heat. These oldest rocks have sunk to a depth of six or eight miles, down below the ocean-floor, where they have been metamorphosed by the heat of the molten liquid below, and whence they have again been slowly shoved up above water-level, with all traces of their organic contents obliterated. This process must have occurred so many times as to have destroyed all but the later records of life. The title "palæozoic," formerly applied to the Silurian rocks, is a misnomer. It was formerly supposed that there were no fossil-bearing rocks below the Silurian. But within a few years the Cambrian and Laurentian strata have been discovered, carrying us back into an antiquity nearly twice as great as

that to which we had reached with the Silurian rocks; and it is now generally admitted that even the Laurentian strata are modern compared with the beginnings of life upon our globe.

But this is not all. Along with the immensely long geologic rhythms, which have thus entailed the periodic metamorphosis of strata, there have been going on minor rhythms, resulting in the alternate deposit and denudation of fossil-bearing strata. Each of the sedimentary strata now surviving was deposited during an epoch of subsidence, and since its elevation to its present position has been more or less denuded. Now it is only during epochs of subsidence that permanent fossil-bearing strata can be deposited. During epochs of elevation the newly formed sedimentary deposit is rapidly disintegrated by the action of coast-waves; and even those thin deposits which are made during an epoch of subsidence are in the next-recurring epoch of elevation soon worn away. It is thus only the thicker strata deposited during an epoch of subsidence which have preserved for our inspection a few specimens of the organisms living at the time when they were deposited.

But in close juxtaposition to this comes the remarkable fact that the most rapid variation among specific forms must take place during

epochs of elevation. For since the only variations preserved by natural selection are those which bring the organism into closer adaptation to its environment; and since in most cases the organic environment of any group of organisms, comprising its enemies, competitors, and prey, is a much more important factor of change than its inorganic environment, comprising climate and soil; it follows that those periods during which groups of organisms, hitherto isolated, are gradually brought into contact with one another must be the periods most favourable for specific change. The most rapid variation, attended by the greatest frequency of transitional forms, will therefore occur during those epochs of elevation when archipelagoes are being converted into continents, and when shallow parts of the sea, hitherto divided by deep channels, are getting practically united together by the diminishing depth of the channel. During such periods it is not only the inorganic agencies of climate and soil which will be altered; the organic environment of each group of organisms will be immensely increased in extent and heterogeneity. The struggle for existence will increase in violence, and there will be an increased amount both of variation and of extinction.

We are thus driven to the remarkable conclusion, not only that each system of fossiliferous strata now remaining has been preceded

and followed by systems destroyed as fast as they were formed, but also that the systems thus destroyed coincided with the periods which must have been richest in transitional forms.

But notwithstanding the extreme imperfection of the geological record, and notwithstanding these special difficulties in the way of finding transitional forms, such forms are frequently met with. Indeed it may be asserted, as one of the most significant truths of palæontology, that extinct forms are almost always intercalary between forms now existing. Not only species, genera, and families, but even orders of contemporary animals, apparently quite distinct, are now and then fused together by the discovery of extinct intermediate forms. In Cuvier's time, horse, tapir, pig, and rhinoceros were ranked as a distinct order from cow, sheep, deer, buffalo, and camel. But so many transitional forms have been found in tertiary strata that pachyderms and ruminants are now united in a single order. By numerous connecting links the pig is now seen to be closely united with the camel and the antelope. Similar results relating to the proboscidians, the hyæna family of carnivora, the apes, the horse, and the rhinoceros, have been obtained from the exploration of a single locality near Mount Pentelikos in Greece. Among more than seventy species there discovered, the gradational arrangement

of forms was so strongly marked, that the great palæontologist, M. Gaudry, became a convert to Mr. Darwin's theory in the course of the search.[1] Referring for many more such examples to the last edition of Sir Charles Lyell's "Principles of Geology," let me further observe that there has as yet been but little search for fossils save in Europe and North America, and even these areas have by no means been thoroughly explored. Concerning South America much less is known, and the greater portions of Asia, Africa, and Australia are just so much *terra incognita* to the palæontologist. As M. Gaudry observes, a few strokes of the pickaxe at the foot of Mount Pentelikos have revealed to us the closest connecting links between forms

[1] We may also profitably consider the toxodon, found by Mr. Darwin in South America, which is "one of the strangest animals ever discovered. In size it equalled an elephant or megatherium, but the structure of its teeth, as Mr. Owen states, proves indisputably that it was intimately related to the Gnawers, the order which at the present day includes most of the smallest quadrupeds: in many details it is allied to the pachydermata: judging from the position of its eyes, ears, and nostrils, it was probably aquatic, like the dugong and manatee, to which it is also allied. How wonderfully," says Mr. Darwin, "are the different orders, at the present time so well separated, blended together in different points of the structure of the toxodon!" Darwin, *Voyage of the Beagle*, p. 82. Compare the remarks on the quaternary fauna of Western Europe in Sir John Lubbock's *Prehistoric Times*, 2d edition, pp. 296–298.

which seemed before very widely separated: far closer will such links be drawn when a considerable portion of the earth's surface shall have been thoroughly investigated.

The argument from "missing links," therefore, in so far as it has any validity at all, is an argument which rests entirely upon negative evidence. But negative evidence, as every one knows, is a very unsafe basis for argument.[1] A single item of positive evidence will always outweigh any amount of negative evidence. A single case in which two or three species of genera are demonstrably connected with each other through lineally intermediate forms, is enough to outweigh the case of a thousand species or genera in which no such linear connection has yet been demonstrated. Now there can be no question that *Equus*, *Hipparion*, and *Anchitherium* are quite distinct genera; and a comparison of the skeletons of the three leaves it equally unquestionable that the hipparion is simply a more ancient horse, and that the anchi-

1 "For instance, the several species of the chthamalinæ (a sub-family of sessile cirrhipeds) coat the rocks all over the world in infinite numbers: they are all strictly littoral, with the exception of a single Mediterranean species, which inhabits deep water, and this has been found fossil in Sicily, whereas not one other species has hitherto been found in any tertiary formation: yet it is known that the genus chthamalus existed during the Chalk period." Darwin, *Origin of Species*, 6th edition, p. 271.

theriuṁ is simply a more ancient hipparion. As Professor Huxley observes: "The process by which *Anchitherium* has been converted into *Equus* is one of specialization, or of more and more complete deviation from what might be called the average form of an ungulate mammal. In the horses, the reduction of some parts of the limbs, together with the special modification of these which are left, is carried to a greater extent than in any other hoofed mammals. The reduction is less and the specialization is less in the hipparion, and still less in the anchitherium; but yet, as compared with other mammals, the reduction and specialization of parts in the anchitherium remain great." [1] But as we go back still farther into the Eocene epoch, we find *Plagiolophus*, a genus intermediate between the horse and the agouti, in which the reduction and specialization of parts is still less. Here, where the exploration has been relatively complete, the intermediate forms are so numerous as to leave no doubt whatever as to the genetic kinship.[2] And similarly of the

[1] *Critiques and Addresses*, p. 195.

[2] I may add that, in particular, numerous extinct forms intercalary between man and ape are likely to be discovered when we search for them in those parts of the earth where they are likely to exist, — namely, in Africa, Madagascar, Southeastern Asia, and the Malay Archipelago. Such forms are not likely, however, to be directly intermediate between man and the gorilla or the chimpanzee. For these are probably

rhinocerotidæ and hyænidæ Professor Huxley says, "it is indeed a conceivable (?) supposition that every species of rhinoceros and every species of hyæna, in the long succession of forms between the Miocene and the present species, was separately constructed out of dust, or out of nothing, by supernatural power; but until I receive distinct evidence of the fact, I refuse to run the risk of insulting any sane man by supposing that he seriously holds such a notion."

It thus appears that the argument from "missing links," which to the general reader may appear so obviously fatal to the Darwinian theory, is to the student of palæontology by no means alarming. Our brief survey of the facts in the case has shown us *first*, that transitional varieties are always likely to have been less numerous in individuals than the well-defined species which they serve to connect; *secondly*, that the geologic eras which have left in the rocks the record of their organic life have been usually the eras in which variation and extinction have been least rapid, and in which accordingly transitional varieties have been least numerous; and *thirdly*, that in spite of all these

aberrant types, and the connection between man and the anthropoid apes is to be sought much lower down, — perhaps near the point of departure of the anthropoid apes from the lower monkeys and lemurs. See the anatomical evidence very well presented in Mr. Mivart's recent work on *Man and Apes*.

adverse circumstances, transitional forms have already been discovered in considerable numbers, while it is fair to expect that many more will be discovered when by and by we have come to know the earth's surface more intimately.

Of all the objections which have been urged against the theory of natural selection, this objection, from the paucity of transitional forms, is the least weighty, though probably the most obvious. The second objection which we have to consider, though less immediately obvious, is more weighty; and though there is no reason for regarding it as insuperable, we must admit that it has not yet been entirely disposed of. This objection is implicated with the difference between the morphological and the physiological definitions of species, and is usually known as the argument from the infertility of hybrids. As ordinarily stated, indeed, this argument is merely the expression of a sorry confusion of ideas. By a curious misunderstanding the infertility of the mule is often urged as a direct objection to the Darwinian theory. But this is putting the cart before the horse. It is not the infertility of the offspring of the horse and the ass which should be cited as an obstacle to the theory of natural selection, but it is the fertility of the offspring of the carrier-pigeon and the pouter, or of the pouter and tumbler. Mor-

phologically the carrier, the pouter, and the tumbler may well be regarded as distinct species artificially developed from a common wild stock; but so long as mutual infertility is held to be the physiological test by which we are to distinguish between varieties and species, it may be argued that, in spite of their great morphological differences, the carrier and the tumbler are only varieties and not true species. And going a step farther, it may be argued that until the theory of natural selection has accounted for the rise of infertility between races descended from a common stock, it has not completely performed the task of reconciling deduction with observation.

Against the derivation theory in general this objection has no weight whatever. That races originally fertile together should, after long subjection to different sets of circumstances, become infertile with one another, is *a priori* in the highest degree probable, when we reflect upon the extreme sensitiveness of the reproductive system to changes of habit in the organism as a whole. When we remember that "the constitution of many wild animals is so altered by confinement that they will not breed even with their own females," we need not be surprised that the leopard and the lion, which during many ages have had very different habits of life, will not breed with each other. Nor

need we wonder that the horse and the ass, with less important differences in general habit, have become partially infertile together, to such an extent that their offspring are hopelessly barren. Though the *modus operandi* of this change is as yet ill understood, it is nevertheless a change quite in harmony with what we know concerning the intimate dependence of the reproductive system upon the rest of the organism. And let us not fail to note that it is the achievement of this change in the capacities of the reproductive system which completes the demarcation between two bifurcating species, and finally prevents the indefinite multiplication of intermediate varieties.

But while this objection has no weight as against the theory of derivation in general, it may fairly be urged that the failure to explain the origination of mutual infertility is, for the present at least, a shortcoming on the part of the theory of natural selection. After the conclusive arguments brought up in our ninth chapter, the derivation theory will no longer, in the present work, be regarded as on trial: that the higher forms of life are derived from lower forms will be taken as proved. But whether the theory of natural selection has completely fulfilled its proposed task of explaining the mode in which such derivation has been brought about, is quite another question. And while

admitting the full force of the considerations alleged by Mr. Darwin, in his admirable chapter on Hybridism, it seems to me that there is a gap at this point which further research will be required to fill.[1] As Professor Huxley reminds us, "it must not be forgotten that the really important fact, so far as the inquiry into the origin of species goes, is that there are such things in nature as groups of animals and of plants, whose members are incapable of fertile union with those of other groups; and that there are such things as hybrids, which are absolutely sterile when crossed with other hybrids. For if such phenomena as these were exhibited by only two of those assemblages of living objects, to which the name of species . . . is given, it would have to be accounted for by any

[1] I doubt if the hypothesis of natural selection, taken alone, will afford the solution of this problem. It seems more likely that such considerations will have to enter as are presented in Mr. Spencer's *Principles of Biology*, vol. i. pp. 209–291. Concerning what may be called the "dynamics of heredity," we know as yet but little; but as far as speculation has already gone, Mr. Darwin's theory of pangenesis seems to me decidedly inferior to Mr. Spencer's theory of physiological units. I do not discuss these theories here, because it is not necessary for the general purposes of this work. It may do no harm, however, to remind some of my readers that "pangenesis" is merely a subsidiary hypothesis, with the possible inadequacy of which Mr. Darwin's main theory is in no way concerned.

theory of the origin of species, and every theory which could not account for it would be, so far, imperfect." [1]

We have now reached a point at which we may pause for a moment to contemplate the theory of natural selection in its logical aspect, and to mark its character as a scientific hypothesis. A moment's inspection will reveal the absurdity of the thoughtless remark — sometimes heard from theologians and penny-a-liners — that the Darwinian theory rests upon purely gratuitous assumptions and can never be submitted to verification. On the contrary, the theory of natural selection, when analyzed, will be found to consist of eleven propositions, of which nine are demonstrated truths, the tenth is a corollary from its nine predecessors, and the eleventh is a perfectly legitimate postulate. Let us enumerate these propositions: —

1. More organisms perish than survive;
2. No two individuals are exactly alike;
3. Individual peculiarities are transmissible to offspring;
4. Individuals whose peculiarities bring them into closest adaptation with their environment are those which survive and transmit their peculiar organizations;
5. The survival of the fittest thus tends to

[1] Huxley, *Lay Sermons*, p. 303.

maintain an equilibrium between organisms and their environments;

6. But the environment of every group of organisms is steadily, though slowly, changing;

7. Every group of organisms must accordingly change in average character, under penalty of extinction;

8. Changes due to individual variation are complicated by the law that a change set up in any one part of a highly complex and coherent aggregate, like an organism, initiates changes in other parts;

9. They are further complicated by the law that structures are nourished in proportion to their use;

10. From the foregoing nine propositions, each one of which is indisputably true, it is an inevitable corollary that changes thus set up and complicated must eventually alter the specific character of any given group of organisms;

11. It is postulated that, since the first appearance of life upon the earth's surface, sufficient time has elapsed to have enabled such causes as the foregoing to produce all the specific heterogeneity now witnessed.

It seems to me that this summary fairly represents the logical character of the theory of natural selection. The theory is so strong that no scientific writer is disposed to deny that the process of natural selection has always gone on

and must continue to go on. And the inference cannot be avoided that in due course of time the process must work specific variations. The only purely hypothetical portion of the theory is the assumption that past geologic time has been long enough to allow of the total process of evolution by such infinitesimal increments. But concerning this assumption, it is the clear verdict of logic, that if the theory is thoroughly substantiated in all its other portions, we have the right to claim as much time as is needful, provided we do not run counter to conclusions legitimately reached by astronomy, geology, or physics. Now concerning the age of the earth, neither astronomy, nor geology, nor physics has as yet had anything conclusive to say ; and it must be left for future inquiries to give us the quantitative data requisite for settling this point.[1] We can-

[1] The reader who wishes to see how fallacious all attempts at reaching the age of the earth from astronomico-physical arguments are likely to prove with our present resources, may consult Huxley's *Lay Sermons*, pp. 268–279.

[See Fiske's further remarks on this subject in the *Excursions of an Evolutionist*, I. The discussion of the physical and geological evidences of the age of the earth has become more prominent in the literature since Fiske wrote the sentences of the text. Lord Kelvin has recently elaborated his earlier physical arguments in favour of a decided limitation of the age of the earth ; and geologists have undertaken new forms of reply. Yet though the question now has more " actuality " than Fiske assigns to it, it is still far from a solution about which authorities agree.]

not yet, indeed, estimate the age of the last great glacial epoch with any approach to accuracy; yet the age which we assign to this epoch must enter as an important factor into our estimates of the antiquity of preceding epochs. But while this point remains undetermined, it may be noted that even the decision which leaves the smallest time for the operation of unaided natural selection can weaken the Darwinian theory only on the assumption that the agency already alleged by that theory has been the sole factor concerned in forwarding organic evolution — and this assumption, though it may have been made by over-confident disciples of Mr. Darwin, has never been made by Mr. Darwin himself. Mr. Darwin is too profoundly scientific in spirit to imagine that, with all his unrivalled patience and sagacity, he has completely solved one of the most intricate problems with which the student of nature has ever been called upon to deal. It is more than likely that future research will disclose other agencies which have coöperated with natural selection in accelerating the diversification of species. Meanwhile the evidence in behalf of the first ten propositions involved in the Darwinian theory is sufficiently strong to make it apparent that a vast amount of specific change must have taken place, and also that natural selection has been a chief factor in producing that change. To the arguments which

in our ninth chapter were seen to overthrow the dogma of fixity of species may now be added the argument that at least one group of clearly defined agencies is at work, with which, in the long run, the fixity of species must become incompatible. The explanation of the details of specific differentiation may well form the subject of cautious investigation for many generations of observers and thinkers. But enough has already been explained to draw forth the undeniable Fact of Derivation from the region of mystery in which it was formerly half hidden, and thus to place the Theory of Derivation upon a thoroughly scientific basis. In expounding the way in which this has been done, we have obtained several useful conceptions, which will not fail to do us good service in future chapters.

CHAPTER XII

ADJUSTMENT, DIRECT AND INDIRECT[1]

AN objection much less obvious than the two considered in the foregoing chapter is brought up by Mr. Mivart against the theory of natural selection. In the Cuvierian classification, the marsupials were ranked as an order of mammalia, side by side with orders like the carnivora or rodentia. This arrangement is now obsolete. The class of mammals is no longer directly divided into orders, but is first separated into three sub-classes, the monodelphia, didelphia, and ornithodelphia. The latter sub-class, forming the link between mammals and sauroids, is now nearly extinct, being represented only by a single order, containing two genera, the Australian echidna and duckbill. Leaving these aside, all other mammals, except the marsupials, are comprised within the sub-class monodelphia. The didelphia or marsupials are divided by Professor Haeckel into eight orders; and between these orders and sundry orders of the higher monodelphia there is a

[1] [See Introduction, § 19.]

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curious parallelism. For example there is an order of edentate marsupials, there is a marsupial order of carnivora, and another of insectivora, and another of rodents, while the kangaroo strongly resembles the sub-order of ruminants, and the opossum is clearly related to the lemurs, or lowest of the primates. It becomes, then, an interesting problem to settle the genetic relationships between the two sub-classes. Did the order of apes descend from the ape-like marsupials, the monodelphian carnivora from the didelphian carnivora, the higher rodents from the marsupial rodents, and so on? If so, it is difficult to see how the pouch should have been lost, and the placenta developed in so many different orders independently: such a number of exact coincidences seem hardly probable. On the other hand, did all the monodelphia descend from one didelphian form? If so, it is strange that the differentiation into orders should have gone on so similarly in the two sub-classes, resulting, for example, in the production of marsupial mice which in general appearance are hardly distinguishable from placental mice.

Birds and reptiles present an equally puzzling cross-relation. Upon no theory are these the direct ancestors of mammals, although the lowest mammals are both bird-like and reptilian in appearance. The duck-bill, belonging to the mammalian sub-class of ornithodelphia, some-

what resembles a lizard with a bird's beak. Embryology shows that the three classes are divergent offshoots from an amphibious or batrachoid ancestor; but the birds and the reptiles resemble each other much more closely than either resembles the mammalia, so that Professor Huxley joins them together in the superclass or province of sauroids. So far all is plain; but when we inquire by what forms the birds and reptiles are linked most closely together, we are met by a difficulty. Birds are divided into two sub-classes: the ostrich, cassowary, emeu, dinornis, etc., are grouped together as *struthious* birds, while all other existing forms belong to the sub-class of *carinate* birds. Now until quite lately it was supposed that all birds were descended from an extinct reptilian form like that ancient reptile, the flying pterodactyl. For the resemblances in structure between the pterodactyls and the carinate birds are striking enough to have suggested an immediate community of origin. Nevertheless, within the past seven years, a much stronger case has been made out in favour of the descent of the struthious birds from large reptilian forms akin to the dinosauria, — of which extinct order the member most commonly known is the gigantic iguanodon. Now here, says Mr. Mivart, is a dilemma just like the one which confronted us in the case of mammals. If all birds started

from the pterodactyl, why do the struthious birds so strongly resemble a totally different reptile? If all birds started from a dinosaurus, why do the carinate birds so strongly resemble the pterodactyl? If we try to split the difference, and say that the carinate birds started from the pterodactyl, while the struthious birds started from the dinosaurus, the difficulty is immensely increased. For then the question arises, how could the struthious and the carinate birds, starting from such different points, have come to resemble each other so strongly?

Mr. Mivart is careful to state that these zoological cross-relations do not constitute an obstacle to the theory of evolution. They are difficulties only on the theory that organic evolution has been solely caused by the natural selection of fortuitous variations. To make this more clear, let us provisionally accept one of each of the pairs of alternatives offered by the two cases just described. Let us agree, with Professor Haeckel, that all the monodelphian mammals have come from one didelphian; and let us agree, with Professor Huxley, that the kinship between birds and reptiles is closest in the case of the struthious birds and the dinosaurians. Now we are obliged to maintain that the original monodelphian branched off into a dozen or more forms, of which six or seven happen to agree remarkably, in general appearance and in

habits of life, with six or seven of the forms into which the original didelphian had at an earlier date branched off. And we are also obliged to maintain that the remarkable shoulder-structure of the pterodactyl, in which it agrees so closely with the carinate birds, was independently evolved and has a purely physiological significance. That is to say, the resemblance of the pterodactyl to carinate birds is a secondary adaptive resemblance, like the less marked resemblance of bats to birds, or like the resemblance of a porpoise to a fish. And this view, which seems to be Professor Huxley's, is rendered probable by the fact that in wing-structure the pterodactyl differs from birds in much the same way that a bat does.

We are now extricated from our imbroglio with regard to classification, but we are still left confronted with the difficulty of supposing that the natural selection of casual variations can so often have resulted in producing whole orders of closely resembling animals from distinct ancestral orders. Other facts, brought up by Mr. Mivart, still further increase the apparent difficulty. The most important of all these relate to the development of the higher organs of sense in the three sub-kingdoms of annulosa, mollusks, and vertebrates. Coincidences between the members of any one of these sub-kingdoms and the members of the others are not to be

attributed to community of origin. No naturalist supposes that an annulose animal, or a true mollusk, has ever been developed into a vertebrate. And while the mollusks and vertebrates appear to have diverged from a molluscoid ancestor akin to the still-living ascidians, the annulose sub-kingdom has a totally different pedigree. To discover any likeness between the two great groups, we must follow them back to those remotest ancestors who possessed hardly any distinctively animal characteristics. Bearing all this in mind, it is a striking fact that the eye of the cuttle-fish, which is the highest of mollusks, appears to be constructed like the eyes of vertebrates. It apparently contains not only a similar retina, but also a lens, the choroid and sclerotic tunics, and the vitreous and aqueous humours. Now this coincidence cannot be due to community of inheritance, for the vertebrate and molluscous sub-kingdoms are linked together only at their lowest extremities, and while the lowest vertebrate has an eye far inferior to the one just described, the molluscoid ascidians have merely rudimentary eye-spots. The coincident structures have therefore been independently developed. Again, Mr. Mivart urges that the agreement cannot be explained on the assumption "that the conditions requisite for effecting vision are so rigid that similar results in all cases must be independently ar-

rived at;" for the eyes of the higher insects, which are excellent visual organs, differ very widely in structure from those of the cuttle-fish and the higher vertebrates. Here, therefore, is a difficulty; and it is still further increased if the alleged fact be true, that there is a similarly close correspondence between the auditory structures in the vertebrates and in the cuttle-fish.

In presenting these difficulties I have closely followed Mr. Mivart, whose scientific arguments are usually stated with a clearness and precision which one would gladly see paralleled in the philosophic discussions by which they are supplemented. I have selected these arguments because they seem to me to constitute the strongest portion of the case which Mr. Mivart has brought to bear against the theory of natural selection — and also because by seeing whither they tend, we shall begin to see how the theory of natural selection must be supplemented, before it can become a complete explanation of the phenomena with which it deals.

Now we must at the outset admit that natural selection must act upon every individual variation which is distinctly advantageous or injurious to the species, — always preserving the former and rejecting the latter. This process must equally go on, whether the variation is a

mere idiosyncrasy, such as we call fortuitous, or whether it is one that is manifested simultaneously by a large number of individuals, so that it may be traced to causes acting upon them all in common. Now this latter case is the one which must here be taken into the account. If a large number of individuals may simultaneously vary in a given direction, and if this may often happen within the limits of single generations, it is obvious that we have here a factor of specific change not to be lightly passed over. In estimating the effects of natural selection upon a number of variations which are, quite legitimately, taken for granted, we must not forget to generalize the variations in connection with some common cause to which they may be assignable. Now it cannot be denied that in any single generation of organisms variations are very likely to occur, throughout nearly the whole number of individuals, which are due to the direct adaptation of the species to its environing circumstances. When exhibited in the effects wrought upon the human constitution by exposure to changed physical conditions, such variations are known as acclimatization. Within the infinitesimal period of two centuries the English race in America has come to differ perceptibly, though very slightly, from the English race in Europe; and this very slight difference, which cannot be explained by the much

overrated hypothesis of the infusion of foreign blood, and which certainly cannot be traced to natural selection, must be almost wholly due to direct adaptation to new physical and social conditions. Of kindred import is the fact that "twenty-nine kinds of American trees all differ from their nearest European allies in a similar manner, having leaves less toothed, buds and seeds smaller, fewer branchlets, etc." So M. Costa states "that young shells taken from the shores of England and placed in the Mediterranean at once altered their manner of growth, and formed prominent diverging rays like those on the shells of the proper Mediterranean oyster." We have seen that the direct action of physical agencies will by no means account for the chief features of colouring in the organic world; yet it appears to be true that members of the same species of birds are more brightly coloured when living in a clear dry atmosphere than when living near the coast. So, too, in the contour of their wings, the various butterflies of Celebes all show parallel divergences, inexplicable by natural selection alone, from kindred species in Java and India. And a host of like facts concerning these insects are cited by Mr. Mivart from Mr. Wallace's essay on the Malayan Papilionidæ. More examples might be cited if this work were intended to be a scientific treatise on Darwinism; but for the compre-

hension of the present point, in its philosophic bearings, these illustrations will suffice.[1]

Facts of this kind point to the conclusion that an inherent capacity for adaptive changes is possessed by all organisms. And by the phrase "inherent capacity" I do not mean to insinuate the existence of any *occulta vis*, or metaphysical "innate power," of which no scientific account is to be given in terms of matter and motion. An organism is a complex system of forces; even the simplest living patch of protoplasm is a highly complex system, but in the higher organisms the complication of forces is almost infinite, when compared with our limited powers of analysis. Now such a system of forces must, under penalty of overthrow, maintain both its internal equilibrium and its equilibrium with external incident forces. And this double maintenance of equilibrium necessitates a rhythmical redistribution of forces from moment to moment, of which, as was shown in the chapter on rhythm, the result must be continual change. Now the internal equilibration of the forces in the organism with each other is generalized in the laws of growth,

[1] [Since the appearance of the discussions of Weissman, the questions here touched upon by Fiske have assumed wholly new forms, and have given rise to an immense literature. For Spencer's later expression and defence of his views, see his *Essays*, Library Edition, vol. i. p. 388–478.]

development, and heredity; while the external equilibration of the forces in the organism with environing forces is generalized in the laws of variation and adaptation. As the result of the former process, all organisms tend to assume certain typical forms, as inevitably as crystals. In the case of the lowest organisms the forms assumed may be possibly due to the operation of chemical polarity similar (though much more involved) to that which gives form to crystals. In all but the lowest organisms the forms assumed are the expression of tendencies due to the coöperation of countless ancestral forces, and such tendencies are now not improperly classified under the head of "physiological polarity," — provided that nothing more is meant by "polarity" than the ability of certain special groups of forces to work different structural changes in different directions. So much for the internal adaptive process. But now, as the result of the parallel process of external adaptation, it follows that the forms due to the internal process can remain constant only so long as the environment remains unchanged. If the changes in the environment are too great or too sudden to be equilibrated by changes in the distribution of the system of internal forces, the system is overthrown, and the organism perishes. But if the external changes are moderate and gradual, the adjustment of the organism to them by

means of internal changes must result in that kind of organic variation known as direct adaptation. We need not be surprised, therefore, by the parallel variations of whole genera of American trees or Malayan butterflies — nor need we ascribe them, with certain recent writers, to "occult energies" of the metaphysical sort, or to a kind of pantheistic "intelligence" inherent in nature, or to any other agency unrecognizable by science; since the necessity for such parallel variations, wherever whole groups of organisms are exposed to like environing agencies, is a corollary from the fundamental principles of vital dynamics.

We are now in a position to amend quite materially the view thus far taken of the causes of organic evolution. Hitherto we have concerned ourselves too exclusively with the selection of variations, omitting to inquire into the character and mode of origin of the variations selected. But the latter point is no less important than the former. If variations might occur equally in all directions from the average standard, by reason of circumstances so indefinitely compounded as to make them seem fortuitous, then the natural selection of such variations might well be pronounced incapable — save in very rare instances — of working entirely analogous results in organisms so genetically distinct as monodelphians and didelphians,

or as vertebrates and mollusks. In other words natural selection, acting upon such fortuitous individual variations, would tend to produce indefinitely increasing differentiations in many directions. Such differentiations are to be seen in the amazingly elaborate contrivances for the fertilization of orchids, the explanation of which is one of Mr. Darwin's most brilliant achievements. But when it is admitted that a great number of similar adaptive variations must be simultaneously occurring in the same direction, then it is obvious that the natural selection of such variations may often produce analogous results in different genera and families, or even in different orders, classes, or sub-kingdoms. Mr. Mivart alleges the many resemblances between whales and the ancient ichthyosaurians as hardly explicable on the theory of the selection of fortuitous variations. But when we recollect that the vertebrate structure of mammals is at the outset homologous with that of reptiles, and that direct adaptation must of itself tend to produce similar variations alike in mammals and in reptiles which pass from a terrestrial into an aquatic environment, the resemblance between a whale and an ichthyosaurus ceases to be an enigma. The superficial resemblance of a whale to a fish is a fact of like nature. And in the case of amphibious carnivora, like the seal, direct adaptation to a partially

marine environment has aided in producing fish-like limbs, while it has not interfered with the general likeness of the animal to certain families of land carnivora. So in the case of the pterodactyl as compared with carinate birds, we begin with skeletons constructed on the same plan, and we may expect to find that direct adaptation to the necessities of flight will tend to produce similar modifications of the shoulder structure. But since, before the appearance of pterodactyls, the dermal covering of reptiles was very likely as different from that of birds as it is now, so that a reptilian wing could not be formed by a modification of the dermal covering, we find, naturally enough, the wing of the pterodactyl formed, like that of the bat, by a modification of the skeleton. And this fact seems to justify us in the alternative which we have accepted, that the likeness of the pterodactyl to birds is no proof of immediate kinship, but only of secondary adaptive variation, as in the case of bats. A similar argument applies to the numerous likenesses between the higher mammals and the marsupials. At an ancient epoch the marsupials were a dominant race of animals, extending all over the world. But since they have been almost everywhere exterminated by their hardier monodelphian descendants, there is no difficulty in the view that direct adaptation to similar differ-

ences of environment, when aided by natural selection, has brought about a differentiation of the higher mammals analogous to that which had formerly taken place among the marsupials. That six or seven orders of monodelphians should vary in the same direction with six or seven orders of didelphians is no more surprising than that twenty-nine kinds of American trees should all differ in the same direction from their European congeners. It is certainly far less surprising than would be the simultaneous loss of a pouch and acquirement of a placenta by a host of marsupial genera scattered all over the earth.

Pursuing the argument a step farther, we may begin to understand, in a general way, even the similarity of the eye of a cuttle-fish to the eye of a vertebrate. Utterly unlike a vertebrate in general structure, — and so remotely akin that for all practical purposes of argument the kinship is of no account, — if a cuttle-fish could be shown to possess numerous points of special resemblance to a vertebrate, the fact would be an obstacle to any theory of the origin of organic forms. But the only special resemblances which are found to exist are those between the eyes and the ears. Now these are organs in which such variations as occur must be in a preëminent degree directly adaptive. The eye, for example, contains an optical apparatus of which the func-

tion is the concentration of rays of light into a focus upon the retina. Such is the function discharged by the lens, and the vitreous and aqueous humours. Now, while the compound eyes of insects show us that this function can be discharged in more than one way, a brief consideration of the optical conditions in the case would show that it can only be accomplished in a few ways. Not only does the passage of the light directly tend to set up molecular rearrangements in the refracting matter which lies before the retina, but out of those rearrangements there are very few which can assist the focalizing process; so that natural selection, in preserving the best-refracting eyes, would have but very few directions in which to act. The anterior membrane might differentiate into a number of converging lenses, as in the higher annulosa, but if such a differentiation did not occur, it is difficult to see how the needful refraction could be secured, save by the differentiation of the successive strata which we call the aqueous, crystalline, and vitreous humours. This may serve to indicate the course of explanation to be taken. The physical conditions for securing very efficient vision being thus limited, and direct adaptation being such an important factor in the process, it does not seem at all strange that two eyes quite similar in structure should be independently produced. A precisely similar argument

will apply to the case of the ear. And the force of these considerations is still further increased when we learn from Professor Gegenbaur that the resemblances between the eyes of vertebrates and the eyes of cuttle-fishes are only superficial analogies, and not fundamental homologies, as Mr. Mivart's very exaggerated statement might lead one to suppose.

In all these cases, here too briefly summed up, natural selection must of course be regarded as steadily coöperating with direct adaptation. No matter whether individual variations are directly called forth by environing agencies, or are due to internal causes, in our ignorance of which we call them fortuitous, they must equally be the objects of natural selection wherever they influence, in the slightest degree, the individual's chances of survival. Thus the theory of natural selection is not superseded, but supplemented, by the class of considerations here suggested by Mr. Mivart's objections. Ordinarily, if not always, the two processes must go on in concert; and while the frequent occurrence of directly adaptive changes must greatly accelerate the operation of natural selection, on the other hand natural selection, by weeding out all cases of retrograde variation, must complete the work of direct adaptation.

There are, however, some conspicuous instances in which natural selection seems to play

either a very subordinate part, or none at all. As we have just been considering eyes and ears, let us once more return to them, to show how certain peculiarities in their structure must be chiefly due to directly adaptive changes. Within the human ear, firmly fastened in the temporal bone, is a spirally coiled chamber, known as the *cochlea.* Within this chamber there is a very elastic membrane, and on it lie the so-called *fibres of Corti*, which are a series of fibrous filaments placed side by side, with great regularity, so as to present somewhat the appearance of the keyboard on a piano. It is now held by physiologists that this row of fibres is really a keyboard, and that each fibre is set in vibration only by a particular musical note, exactly as an A-tuning-fork is set vibrating when A is sounded near it, but not when any other note is sounded.[1] The auditory nerve, in passing into the cochlea, branches into an immense number of nerve filaments, each of which communicates with one of the keys of this ear-piano. So that when A is sounded on a musical instrument, the A-key within the ear vibrates, and transmits its vibrations to a special filament of the auditory

[1] [The hypothesis here stated has since been altered in current literature in the sense of regarding, not the rods of Corti, but the fibres of the basilar membrane as constituting the "key-board" in question. Fiske would have modified this passage accordingly.]

nerve. If this view be correct, we have here a truly marvellous instance of differentiation. But now in what way can this structure have ever been useful to human beings in the struggle for life? Doubtless a considerable power of discriminating sounds is useful to any animal, but of what use can it be to distinguish between A and A-sharp? We may safely conclude, I think, that survival of the fittest has played quite a secondary part in this case. The explanation must be sought in the direct effects wrought by auditory vibrations upon the molecular structure of the cochlear fibres. And it is a system of effects which has not even yet been wrought in its present completeness save among highly civilized people. A savage cannot distinguish the slight variations in pitch by which our ears are delighted. And even among ourselves there are ears which can neither in melody discriminate between the ascending and the descending gamut, nor in harmony distinguish between the mellifluous tonic chord and the harsh inversions of the minor ninth. The defect may be compared to that of colour blindness, although it is probably more common because the ear has been far less thoroughly trained than the eye. Now when we consider how much can be effected by individual training in enabling a moderately good ear to discriminate between quarters, eighths, and smaller fractions of a tone, and bear

in mind that this training must consist in the further differentiation of the sensitive cochlear fibres, we have a strong argument in favour of the production of this wonderful structure by direct adaptation alone.

Concerning the human eye I need only say that in the retina it presents a structure closely analogous to the ear-piano just described. The chief layer of the retina is composed of little rods of nerve tissue, packed closely together like organ pipes; and it is probable that each of these rods vibrates in unison with a particular ray of light.[1] Here is a case of extreme differentiation just like that witnessed in the ear; and substantially the same argument will apply to it. The survival of a primeval savage in the struggle for life would certainly depend to a considerable extent on his ability to discriminate certain colours as well as outlines by the eye, as also upon his ability to recognize the *timbre* or quality of certain sounds. But the power of distinguishing the delicate shades in a painting of Correggio

[1] This is the opinion of Helmholtz, the greatest living authority; and it is strengthened by Dr. Brown-Séquard's discovery of the number of fibres in the spinal cord which are specialized for the reception of particular sensations. [The passage in the text above, and in this note, regarding the functions of the retina, would have been greatly modified had Fiske rewritten it in the light of recent knowledge. The theory of the colour sensations has been much changed by the researches since Helmholtz.]

could be no more useful, from a zoölogical point of view, than the power of appreciating the most subtle harmonic effects in a symphony of Schumann. For this extreme differentiation there would seem to be no assignable cause save the direct action of luminous waves upon the wonderfully sensitive and responsive nerve tissue of civilized men.

Were it needful for the further illustration of our position, I might show how Mr. Spencer has proved that the structure of vertebral columns is also primarily due to directly adaptive changes. Many peculiarities in the shapes of plants and animals are probably thus to be explained. And in regard to the hues of organisms — those phenomena which are so beautifully explained by the Darwinian theory — there are some exceptions to be cited. The magnificent tints of many corals, of certain caterpillars, and of the shells of sundry mollusks, must undoubtedly be due to the direct working of such chemical affinities as produce our wonderful aniline dyes, or the rich tints of our American autumn woods.

But passing over all these interesting points, enough has been said to show that there are many phenomena of organic evolution which natural selection, when considered alone, will not suffice to account for. But with the amend-

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ments now agreed upon, there may be framed an outline of a tolerably complete classification of agencies. Let us reduce to a common form of expression the agencies contemplated in this and in the two preceding chapters.

Considered in the widest sense, the processes which we have seen to coöperate in the evolution of organisms are all processes of equilibration or adjustment. From the dynamical point of view, as has been shown in previous chapters, an organism is a complex aggregate of matter, in which permanent structural and functional differentiations and integrations are rendered possible by the fact that it continually receives about as much motion as it expends. Now a state in which expended motion is continually supplied from without is called a state of *dependent moving equilibrium*. In other words, it is a state in which every change in the distribution of external forces must be met by a change in the distribution of internal forces, in order that the equilibrium may be preserved. This is the case with every organism. Its life is a perpetual balancing of external forces by internal forces. And the complete accomplishment of this end requires also that there shall be a continuous internal equilibration, — a perpetual balancing of forces operative in the different parts of the organism. Thus the career

of an organism, or of a group of organisms, consists of two kinds of equilibration, which we may briefly designate as external and internal equilibration. And a moment's consideration will show us that each of these kinds of equilibration may be either direct or indirect. The adjustment of a group of organisms to changing external circumstances is effected partly by such direct adaptations as we have above considered, partly by the destruction of all those members of the group which do not become directly adapted. In this latter way equilibrium is maintained indirectly; and natural selection, or survival of the fittest, may be accurately characterized as "indirect equilibration." Turning now to the internal processes, we see that direct equilibration which consists in continually arranging all the units of the organism in accordance with their physiological polarities exemplified alike in heredity and in correlation of growth. On the other hand, the dwindling and final evanescence of organs which are disused is due to the fact that the nutritive material is all needed by the other organs which are in constant use; and it may accordingly be regarded as an indirect method of preserving the internal equilibrium of the organism. The process of organic evolution may therefore be summarized as follows: —

Equilibration	External	Direct	*Adaptation.*
		Indirect	*Natural Selection.*
	Internal	Direct	*Heredity.*
			Correlation of Growth.
		Indirect	*Use and Disuse.*

Here we have a classification of agencies co-extensive with our present knowledge of the subject, and sufficiently comprehensive to include such factors in the problem as may hereafter be discovered. Under one of these four subdivisions every special process concerned in forwarding organic evolution must be included. For since it is admitted on all sides that specific change is due to the necessity for maintaining equilibrium between the organism and the environment, it follows that every process which results in the modification of species must be a process of adjustment or equilibration, either external or internal, direct or indirect. In the scientific treatment of the problem, there is room for much beside natural selection, but there is no room for *occultæ vires*, or pantheistic intelligences, or for "tendencies," save such as may be expressed as the unneutralized surplus of forces acting in a particular direction.

But we have now done something more than merely to classify the causes of organic evolution. In the act of classifying these, we have arrived at the law or formula which expresses the chief characteristic of organic evolution.

We have reached the all-important truth that the progress of life on the globe has been the continuous equilibration of the organism with its environment. We need now only go a step farther in order to obtain a formula which will not only express the distinguishing characteristic of Life itself, but will also serve as an immediate basis for our inquiries into the phenomena of mind and of society.

CHAPTER XIII

LIFE AS ADJUSTMENT[1]

ONE of the cardinal propositions of Mr. Spencer's system of philosophy is the definition of Life, first published in 1855, in his "Principles of Psychology," but now transferred to the first volume of his "Principles of Biology." According to Mr. Spencer, the continuous maintenance of an equilibrium between the organism and its environment is the process in which life essentially consists. Life — including also intelligence as the highest known manifestation of life — is the continuous establishment of relations within the organism, in correspondence with relations existing or arising in the environment.[2] Out

[1] [See Introduction, § 19.]

[2] The full definition runs thus: "Life is the definite combination of heterogeneous changes, both simultaneous and successive, in correspondence with external coexistences and sequences." This is incomparably the most profound and complete definition of Life that has ever been framed; and the chapter in which it is set forth and illustrated would alone entitle Mr. Spencer to a place among the greatest thinkers that have ever lived. The objection has indeed been raised, in metaphysical quarters, that this is a definition, not of Life, but

of the host of illustrations by which this formula is justified, it will be sufficient for our present purpose to select but one or two. "The stinging and contractile powers of a polyp's tentacle correspond to the sensitiveness and strength of the creatures serving it for prey. Unless that external change which brings one of these creatures in contact with the tentacle were quickly followed by those internal changes which result in the coiling and drawing up of the tentacle, the polyp would die of inanition. The fundamental processes of integration and disintegra-

of the circumstances or accidents in which Life is manifested. Concerning this objection, we may content ourselves with the following remarks by Mr. Lewes. Both Life and Mind, says Mr. Lewes, are *processes*. "Neither is a substance — neither is a force. To speak of Vitality as a substance would shock all our ideas; but many speak of it as a force. They might with equal propriety hold Mortality to be a force. What, then, is meant by Vitality, or vital forces? If the abstraction be resolved into its concretes, it will be seen that a certain process, or group of processes, is condensed into a simple expression, and the final result of this process is transposed from a resultant into an initial condition, the name given to the whole group of phenomena becomes the personification of the phenomena, and the *product* is supposed to have been the *producer*. In lieu of regarding vital actions as the dynamical results of their statical conditions, the actions are personified, and the personification comes to be regarded as indicating something independent of and antecedent to the concrete facts it expresses." *Problems of Life and Mind*, vol. i. p. 110.

tion within it would get out of correspondence with the agencies and processes without it; and the life would cease." So in higher animals, "every act of locomotion implies the expenditure of certain internal mechanical forces, adapted in amounts and directions to balance or out-balance certain external ones. The recognition of an object is impossible without a harmony between the changes constituting perception, and particular properties coexisting in the environment. Escape from enemies supposes motions within the organism, related in kind and rapidity to motions without it. Destruction of prey requires a particular combination of subjective actions, fitted in degree and succession to overcome a group of objective ones. And so with those countless automatic processes exemplified in works on animal instinct."[1] And similarly, as will appear still more clearly when we come to treat especially of the evolution of intelligence, "the empirical generalization that guides the farmer in his rotation of crops, serves to bring his actions into concord with certain of the actions going on in plants and soil; and the rational deductions of the educated navigator who calculates his position at sea, constitute a series of mental acts by

[1] [Spencer, *Principles of Biology*, vol. i. Part I. chapter v. § 28.]

which his proceedings are conformed to surrounding circumstances." [1]

We practically recognize the truth of this definition of life when we attempt to ascertain whether an animal is dead or alive by poking it with a stick. If it responds by motions of its own, we judge it to be alive; if it merely moves as the stick pushes it, we judge it to be dead. So we decide whether a tree is alive or dead by observing whether the increased supply of solar radiance in spring causes those internal motions which result in the putting forth of leaves. In these cases we recognize the truth "that the alteration wrought by some environing agency on an inanimate object does not tend to induce in it a secondary alteration, that anticipates some secondary alteration in the environment. But in every living body there is a tendency towards secondary alterations of this nature; and it is in their production that the correspondence consists."

This formula for vital phenomena is further illustrated and justified by the fact that the degree of life is low or high, according as the correspondence between internal and external relations is simple or complex, limited or extensive, partial or complete, imperfect or perfect. The lowest forms of life respond only to the

[1] [Spencer, *Principles of Biology*, Part I. chapter v. § 28.]

simpler and more homogeneous changes which affect their total environment. The relations established within a plant answer only to the presence or absence of a certain quantity of light and heat, and to the chemical and hygrometric relations existing in the enveloping atmosphere and subjacent soil. In a polyp, besides general relations similar to these, certain more special relations are established in correspondence with the external existence of mechanical irritants; as when its tentacles contract on being touched. The increase of extension acquired by the correspondences as we ascend the animal scale may be seen by contrasting the polyp, which can simply distinguish between soluble and insoluble matters, or between opacity and translucence, in its environment, with the keen-scented bloodhound and the far-sighted vulture. And the increase of complexity may be appreciated by comparing the motions respectively gone through by the polyp on the one hand, and by the dog and vulture on the other, while securing and disposing of their prey. In the next chapter it will be shown that the advance from lower to higher forms of life consists in the orderly establishment of relations within the organism, answering to external relations of coexistence and sequence, that are continually more special, more remote in space and in time, and more heterogeneous; until at

last we reach civilized man, whose intelligence responds to every variety of external stimulus, whose ordinary needs are supplied by implements of amazing complexity, and whose mental sequences may be determined by circumstances as remote as the Milky Way and as ancient as the birth of the Solar System.

When viewed under this aspect the phenomena of life and of intelligence are so similar that it is difficult to keep them separate in our series of illustrations. As we proceed to treat of psychology, we shall much better appreciate the importance of the truth which I am now expounding. Restricting ourselves here, as far as possible, to physiological illustrations, let us note that in any organism life continues just so long as relations in the environment are balanced by internal relations, and no longer. The difference in result between a jump from a horse-car and a jump from an express train running at full speed depends simply on the difference in the ability of the contracting muscles to neutralize a small or a large quantity of arrested momentum. The motor energy with which the head is carried forward until it strikes the ground is exactly the surplus of external force to which the organism has failed to oppose an internal force. If the resulting concussion of the brain is not so great as to induce instant death, but only causes inflammation, with

temporary loss of consciousness, then the continuance of life will depend upon the ability of the molecular forces within the organism to bring about a redistribution of matter and motion which shall balance the sudden redistribution caused by the blow. Dynamical pathology regards all diseases as disturbances of the internal equilibrium of the organism, and recovery is the restoration of the equilibrium. The avoidance of danger is the coördination of certain actions in anticipation of more or less complex relations about to arise without. If disease and danger be successfully avoided, the death which ensues in old age is due to the diminished plasticity of the organism which renders it incapable of responding to external changes. As we saw when treating of the primary aspects of Evolution and Dissolution, the evolution of the body, even to the close of life, is characterized by the integration of its constituent matter, shown in the increasing proportion of solids to fluids, which makes the bones brittle, the muscles stiff, and the nerves sluggish. Death from old age ensues just when the consequent molecular immobility has reached the point at which incident forces can no longer be balanced by internal rearrangements.

A paragraph will suffice for the exposition of this formula of life in connection with the general law of evolution. That the evolution of

life upon the earth, beginning with innumerable jelly-like patches of protoplasm, like the monera discovered by Professor Haeckel, and ending with more than two million species of plants and animals such as naturalists classify, has been a change from homogeneity to heterogeneity, will be denied by no one. Nor is it needful to repeat, save for form's sake, what was sufficiently illustrated in an earlier chapter, — that the higher forms are also those in which the various orders of integration are most completely exemplified. We need only to note that the continuous adjustment of the organism to its environment, in which process we have seen that life consists, must necessitate both the differentiation of the organism and the integration or definite combination of the changes which constitute its activity. For as the life becomes higher the environment itself increases in heterogeneity as well as in extent. The environment of a fresh-water alga is, as Mr. Spencer remarks, limited to the ditch or pool in which the alga lives. The acaleph borne along on a wave of the sea has a much more homogeneous environment than the caterpillar which crawls over leaves; and the actions by which the caterpillar must "meet the varying effects of gravitation" are far more heterogeneous than the actions of the acaleph. In the case of the higher animals, not only is their environment extremely

heterogeneous as consisting to a great extent of adjacent organisms which stand to them in the relations of enemies, competitors, or prey; but it also presents highly coördinated actions on the part of these organisms, which must be met by highly coördinated actions on the part of the former. Thus with the increase of the organism in heterogeneity, definiteness, and coherence, its environment increases in heterogeneity and presents more definite and coherent relations to which the organism must adjust itself. And in this way the heterogeneous, definite, and coherent activity of the organism is again enhanced. The corollary from this group of truths is one which will nearly concern us when we come to treat of the Evolution of Society: it is this — the greater the amount of progress already made, the more rapidly must progress go on.

CHAPTER XIV

LIFE AND MIND[1]

BEFORE we proceed to treat of physical life as the continuous establishment of subjective relations that are in correspondence with environing objective relations, we must dispose of certain questions which have been raised by Comte and his disciples concerning the right of psychology to be regarded as an independent science. Part of Comte's plan for the renovation of philosophy was the rescuing of psychology from the exclusive control of metaphysicians. The manner in which he proposed to accomplish the rescue is only too briefly described: he simply denied *in toto* the claims of psychology to be regarded as an independent science. According to Comte there can be no science, worthy of the name, founded upon the observation and comparison of states of consciousness; and psychology must therefore be studied as a part of biology, by the aid solely of the methods used in biology. That is, the study of mind must be reduced to the study of nervous phenomena simply. It is easy

[1] [See Introduction, § 20.]

to say that the inevitable outcome of this is the unqualified assertion of materialism. But as Comte himself never drew such an inference, and always protested energetically against materialism, as based upon illegitimate inferences from the study of nervous phenomena, it would not be fair in us to draw the inference for him and then upbraid him with it. This kind of misrepresentation is dear to theologians, and we may contentedly leave them an entire monopoly of it. But worse remains behind. Having condemned psychological analysis as useless, Comte offers us in exchange the ludicrous substitute — Phrenology !

Of all the scientific blunders which Comte ever made, this was beyond question the one which has done most to injure his credit with competent scientific critics. Yet in fairness we must remember that Comte's ignorance of psychology was his weakest point, and that forty years ago, when the anatomy and physiology of the nervous system were in their infancy, the conception of dividing the gray surface of the cerebrum into thirty or more provinces, each the seat of a complex group of mental aptitudes, did not seem so absurd as it does now. In those days even Broussais, a first-class physiologist, adopted some of the leading doctrines of phrenology. Moreover the fundamental conception of Gall — which included the ana-

tomical comparison of all animal brains, in connection with the study of the mental characteristics of animals — was a noble conception; though in working it out he showed himself lamentably ignorant of the plainest rules of induction. The purposes of our inquiry do not render it necessary for me to discuss the merits of a hypothesis which has long since ceased to be of any interest, save as an episode in the early history of physiological psychology. Those who wish to see the question treated critically may be referred to the works of Müller, Valentin, Wagner, Vulpian, Gratiolet, Longet, and especially of Lélut; to the appendix to Hamilton's "Lectures on Metaphysics;" to the chapter on Gall in Mr. Lewes's "History of Philosophy;" and to Mr. Bain's treatise on "The Study of Character."

It is not Comte's acceptance of phrenology, but his denial of psychology, which here concerns us. The former is merely a personal question, bearing upon Comte's scientific competence; the latter is a question of general interest. We may note at the outset that many contemporary positivists differ from Comte on this point. It is generally agreed that a science may be founded, even if it has not already been founded, upon the observation and comparison of states of consciousness; though there is some disagreement as to the position of that science

with reference to the other sciences. Mr. Lewes, for instance, misled by his general adherence to the Comtean classification of the sciences, regards psychology as a subdivision of biology, on the ground that the phenomena of consciousness are merely a special division of the phenomena of life. This is, in one sense, true; so true, indeed, as to be fatal to the conclusion which it is meant to support. For it may be said, with equal truth, that the phenomena of life are but a subdivision of the phenomena presented by the surface of our contracting and cooling planet; so that it might equally well be argued that biology is only a subdivision of geology. And again it may be said that geologic phenomena are only a subdivision of the general phenomena presented by the condensation of a nebula; so that geology is only a branch of astronomy. Yet it could hardly be said that psychology is a mere branch of astronomy; so that here we seem to have reached a *reductio ad absurdum.*

But by travelling back over the course we shall get out of the difficulty, and not only see why psychology has as good a right as any other branch of inquiry to be ranked as an independent science but also see why it must needs be partly founded upon an observation and comparison of states of consciousness. Let us then,

having reached the primeval nebula, begin our journey backwards.

Our position is explained by the consideration that all the synthetic concrete sciences are but adjacent tracts of one general science, — Cosmology. "Practically, however, they are distinguishable as successively more specialized parts of the total science — parts further specialized by the introduction of additional factors. The astronomy of the solar system is a specialized part of that general astronomy which includes our whole sidereal system; and becomes specialized by taking into account the revolutions and rotations of planets and satellites. Geology is a specialized part of this special astronomy; and becomes specialized by joining, with the effects of the earth's molar motions, the effects of continuous decrease in its internal molecular motion, and the effects of the molecular motion radiated from the sun. Biology is a specialized part of geology, dealing with peculiar aggregates of peculiar chemical compounds formed of the earth's superficial elements — aggregates which, while exposed to these same general forces, molar and molecular, also exert certain general actions and reactions on one another. And psychology is a specialized part of biology, limited in its application to a higher division of these peculiar aggregates, and occupying itself exclusively with those spe-

cial actions and reactions which they display, from instant to instant, in their converse with the special objects, animate and inanimate, amid which they move." [1]

This last point is one which requires further illustration. Concisely expressed, it amounts to this — that psychology is distinguished by dealing in a particular way with the relations between the organism and its environment. A few illustrations will render this perfectly intelligible — will show us that mere nervous physiology is not, and never can be, psychology.

Nervous physiology treats of relations subsisting within the organism. It explains how waves of molecular motion, set up in a nerve centre and transmitted along a nerve axis, cause contraction in the fibres of a muscle, or secretion in a gland, or molecular rearrangement in the substance of the tissues, or set up a new molecular undulation in some other nerve centre. It seeks to formulate the conditions under which nervous stimulation and nervous discharge take place. Or it shows how certain feelings are invariably sequent upon certain rearrangements of the molecules composing the nerve substance. Even if it recognizes, as it does continually recognize, some force external to the organism, which causes the molecular re-

[1] Spencer, *Principles of Psychology*, vol. i. pp. 137, 138.

arrangement and the resultant feeling, it nevertheless does not concern itself with the relation between the external cause and the internal effect, but only with the internal effect.

Now, as Mr. Spencer has forcibly pointed out, "so long as we state facts of which all the terms lie within the organism, our facts are anatomical or physiological, and in no degree psychological. Even though the relation with which we are dealing is that between a nervous change and a feeling, it is still not a psychological relation so long as the feeling is regarded merely as connected with the nervous change, and not as connected with some existence lying outside the organism. . . . For that which distinguishes psychology from the sciences on which it rests is that each of its propositions takes account both of the connected internal phenomena and of the connected external phenomena to which they refer. In a physiological proposition an inner relation is the essential subject of thought; but in a psychological proposition an outer relation is joined with it as a coessential subject of thought. A relation in the environment rises into coördinate importance with a relation in the organism. The thing contemplated is now a totally different thing. It is not the connection between the internal phenomena, nor is it the connection

between the external phenomena; but it is *the connection between these two connections.* A psychological proposition is necessarily compounded of two propositions, of which one concerns the subject and the other concerns the object; and cannot be expressed without the four terms which these two propositions imply. The distinction may be best explained by symbols. Suppose that A and B are two related manifestations in the environment — say, the colour and taste of a fruit; then, so long as we contemplate their relation by itself, or as associated with other external phenomena, we are occupied with a portion of physical science. Now suppose that X and Y are the sensations produced in the organism by this peculiar light which the fruit reflects, and by the chemical action of its juice on the palate; then, so long as we study the action of the light on the retina and optic centres, and consider how the juice sets up in other centres a nervous change known as sweetness, we are occupied with facts belonging to the science of physiology. But we pass into the domain of psychology the moment we inquire how there comes to exist within the organism a relation between X and Y that in some way or other corresponds to the relation between A and B. Psychology is exclusively concerned with this connection between A B and

x y: it has to investigate its nature, its origin, and its meaning." [1]

It is true, as the last chapter showed us, that biology also presupposes a reference to phenomena outside the organism, the very definition of Life being "the continuous adjustment of internal relations to external relations;" so that Mind here appears to be but the highest form of Life. We see here the difficulty of sharply demarcating adjacent provinces of nature. Nevertheless there is a broad distinction, though not a sharp one. Exclude from biological problems all those adjustments which constitute mental reaction upon the environment, and the only external factors remaining are those general conditions of temperature, moisture, food and the like, which are taken for granted once for all. While in each special problem of psychology the relation between internal and external relations is the main subject of inquiry, on the other hand, in special problems of biology, the relation between the internal processes and these general external factors is not the chief, but a subordinate, subject of inquiry. Digestion, for instance, implies food; and "food implies neighbouring plants or animals; but this implication scarcely enters into our study of digestion, unless we ask the

[1] Spencer, *Principles of Psychology*, vol. i. p. 132. [Part I. chapter vii. § 53.]

quite special question — how the digestive organs become fitted to the materials they have to act upon." But a moment's introspection will make it clear to every one "that he cannot frame any psychological conception without looking at internal coexistences and sequences in their adjustments to external coexistences and sequences. If he studies the simplest act of perception, as that of localizing a touch in some part of his skin, the indispensable terms of his inquiry are: on the one hand a thing (1) and a position (2), both of which he regards as objective; and on the other hand a sensation (3), and a state of consciousness constituting his apprehension of position (4), both of which he regards as subjective. Or, if he takes for his problem one of his complex sentiments, as that of justice, he cannot represent to himself this sentiment, or give any meaning to its name, without calling to mind actions and relations supposed to exist in the environment: neither this nor any other emotion can be aroused in consciousness even vaguely, without positing something beyond consciousness to which it refers."[1]

Let us observe, in passing, that these considerations are quite incompatible with Materialism. The doctrine of the materialists rests partly on the assumption that the study of the laws of

[1] Spencer, *Principles of Psychology*, vol. i. p. 133.

nervous action can give us a complete account of mental phenomena. But we have seen that to understand the simplest act of perception, we must take into the account not only the subjective and the objective factors, but the relation between the two. It is this relation which constitutes the perception. But this relation exists only in consciousness, and we cannot explain it save by direct observation of consciousness. Push our researches in biology as far as we may, the most we can ever ascertain is that certain nerve changes succeed certain other nerve changes or certain external stimuli in a certain definite order. But all this of itself can render no account of the simplest phenomenon of consciousness. As Mr. Spencer well says, "such words as *ideas*, *feelings*, *memories*, *volitions*, have acquired their several meanings through self-analysis, and the distinctions we make between sensations and emotions, or between automatic acts and voluntary acts, can be established only by comparisons among, and classifications of, our mental states. The thoughts and feelings which constitute a consciousness, and are absolutely inaccessible to any but the possessor of that consciousness, form an existence that has no place among the existences with which the rest of the sciences deal. Though accumulated observations and experiments have led us by a very indirect series of inferences to the belief

that mind and nervous action are the subjective and objective faces of the same thing, we remain utterly incapable of seeing, and even of imagining, how the two are related. Mind still continues to us a something without any kinship to other things."

Thus we conclude that psychology — though, from the objective point of view it may be regarded as a branch of biology, in the same abstract sense in which biology may be regarded as a branch of geology, and geology as a branch of astronomy — has nevertheless an equal claim with any of these to be ranked as a distinct science. From the subjective point of view it has a superior claim to any of the others. Since here the phenomena studied are directly given in the consciousness of the investigator, there arises a distinction more fundamental than those by which the various departments of objective science are marked off from each other. And, indeed, without some of the data furnished by this unique subjective science, it is impossible to obtain the premises of philosophy; as will at once be admitted, on recollecting the topics which occupied us in the first part of this work. Psychology is therefore distinct alike from biology and from other sciences, in its problems and in its theorems. The problem of biology is to formulate the laws of nutrition and reproduction, muscular contraction and nervous irri-

tation, heredity and adaptation. The problem of psychology is to formulate the laws of Association, — the order in which certain relations among environing phenomena give rise to certain corresponding relations among our states of consciousness. And while the theorems of objective science in general are based upon the observation of objective phenomena, whether external or internal to the organism, the theorems of psychology are based not only upon the observation of objective phenomena, but also upon the observation of subjective states.

In view of these results, we see how hopelessly Comte went astray. Rejecting all introspection as metaphysical and delusive, he would have had us confine our inquiries to the succession of those nervous phenomena which are the invariable concomitants of feelings, ignoring the fact that without introspective observation we can never even ascertain that there *is* any invariable concomitance between the feelings and the nervous phenomena. He would have us solve a problem in which two factors are concerned, by investigating only one factor.

In giving his reasons for thus rejecting all observation of consciousness, Comte reveals his inability (upon which I have already frequently remarked) to distinguish between psychology and metaphysics. He insists that psychologic inquiry, as hitherto conducted, has not re-

sulted in discovery. If this were true, it would not help his case. Metaphysical psychologists have failed in discovery, not because they have directly examined states of consciousness, but because they have constructed unverifiable hypotheses about the nature of Mind in itself. Where they have abstained from ontological inquiries, and have contented themselves with scientific methods, psychologists have made discoveries. To say nothing of such recent inquirers as Bain, Wundt, Fechner, and Taine, it may be fairly claimed that, among older speculators, Hobbes, Locke, Leibnitz, Berkeley, Hume, Kant, and Hartley, have by psychologic analysis made real and permanent contributions to our knowledge of mental operations. And at the very date when Comte was preparing his great treatise for publication, there appeared a remarkable book which, by establishing some of the fundamental laws of Association, went far toward placing psychology upon a scientific basis. It is not to the crude and superficial Gall, as Comte would have us believe, that we must give the respect due to the founder of scientific psychology: that respect is due, in far greater degree, to James Mill, the illustrious author of the "Analysis of the Human Mind."

Nevertheless, while psychology is a science clearly distinct from biology, dealing with phe-

nomena which may be classed as super-organic, and using introspective observation as one of its main implements of inquiry, it is no more than any other an absolutely independent science. Since the phenomena of Mind are never manifested to us save in connection with the phenomena of Life, and since the same general formula expresses the fundamental characteristics of the two groups of phenomena, it follows that no complete science of psychology can be constituted without the aid of biology. The conclusions reached by the analysis of subjective states must be shown to be in harmony with the conclusions reached by the synthesis of objective phenomena, before the scientific interpretation of Mind can be regarded as entirely satisfactory. The force of this statement becomes at once apparent, when we recollect that introspective observation can inform us only concerning the mental processes which go on in adult civilized men. In order to understand the genesis of these mental processes, we need the assistance of objective psychology and of nervous physiology; we need to compare the mental processes observed in adult civilized men, with the mental processes observed or inferred in civilized children, in adult barbarians, and in the lower animals, down to those humble organisms in which the phenomena of intelligence first become differentiated from the

phenomena of organic life. The immense advance which has been made in mental science during the past forty years has been mainly due to the practical recognition of this fact. Treatises on psychology are no longer solely based upon an analysis of what happens when "I see the inkstand," although analyses of this sort are still, as is here maintained, indispensable. The nervous system, in its ascending complications from the amphioxus to man, is now taken into the account. The normal variations in psychical manifestation, in the various human races, from childhood to old age, are taken into the account. The abnormal variations caused by stimulants and narcotics, as well as those exhibited in epilepsy, insanity, and other forms of nervous disease, are taken into the account. And careful investigations into the ways in which different organisms respond to external stimuli, show us that the lower forms of psychical activity are no longer neglected. While the analysis of complex mental operations has been pushed to an extent which until lately would have been deemed impracticable, on the other hand the sub-science of psychogeny, dealing with the origin of the various manifestations of mental activity, has arisen to coördinate importance with subjective psychology. It has become generally recognized that — ineffaceable as is the distinction between the pheno-

mena of consciousness and all other phenomena — nevertheless the one as well as the other can be scientifically explained only when present manifestations are studied in their connection with past manifestations. In this domain, as in all others, the Law of Evolution holds sway.

Let us now, in accordance with these general considerations, begin by contemplating the phenomena of Mind as gradually differentiated from the phenomena of Life; reserving for another chapter the interpretation of sundry psychological truths in terms of the law of evolution. And first let us reconsider the definition of life which was briefly illustrated in the preceding chapter. We saw that life essentially consists in the continuous adjustment of relations within the organism to relations in the environment. And we saw that the degree of life is low or high, according as the correspondence between internal and external relations is limited or extensive, partial or complete, simple or complex. We saw that the lowest forms of life respond to the changes going on about them only in a simple, imperfect, and general way. A tree, for instance, meeting by changes within itself none but physical and chemical changes which occur with general uniformity in the environment, exhibits life in a very simple and unobtrusive form. We habitually regard it as less alive than a polyp, because the polyp, by displaying nascent sensi-

tiveness and contractility, responds to a greater variety of more special external stimuli. Yet the polyp, possessing no specialized organs of sense, can oppose but one sort of action to many diverse kinds of impression. Phenomena so different as those of light and heat, sound and mechanical impact, can affect it in but one or two ways, — by causing it to move, or by slightly altering its chemical condition. The modes of response to outer relations are few and homogeneous. Passing abruptly to civilized man, at the other end of the animal scale, we find a different state of things. To each kind of external stimulus there are many possible modes of response. Not only, for example, does the human organism sharply distinguish between variations which affect the eye and those which affect the ear; not only do eye and ear, which are themselves organs of amazing complexity, discern an endless number of differing tones and hues, as well as a great variety of intensities and qualities; but each particular manifestation of sound or of light is capable of arousing in the organism very different psychical combinations, entailing different muscular actions, according to circumstances. Tennyson's traveller, who, walking at nightfall in a strange land, hears the moaning of a distant sea, —

"And knows not if it be thunder, or a sound
Of rocks thrown down, or one deep cry
Of great wild beasts," —

will adopt a course of action more or less in conformity with environing relations, according to the degree of his sagacity and the extent of his experience. Streaks of light and strata of cloud in the horizon will lead the practised mariner and the unskilled passenger to different conclusions. A cartoon of Raphael or a symphony of Beethoven will excite different emotions in an artist and in a person of feeble impressibility. And from the swinging of a cathedral lamp the young Galileo drew inferences which had escaped the attention or baffled the penetration of thousands of less acute beholders. Thus, with civilized man, the modes of response to outer relations are almost infinitely numerous and heterogeneous.

But now, in this briefly indicated contrast between the lowest and highest extremes of life, regarded as a correspondence between the organism and the environment, we have passed abruptly from vital relations which are purely physical to vital relations which are almost purely psychical. The relations contemplated have been, in each of the instances, relations internally set up in adjustment to external relations. But while the relations set up within the tree are simply physico-chemical; and while the

relations set up within the polyp, though involving nascent sensitiveness, are nevertheless, in the absence of specialized nerve matter, unattended by consciousness, and therefore cannot strictly be classed as psychical; on the other hand, the relations set up within civilized man are almost purely psychical, involving only such physico-chemical elements as are necessitated by the fact that conscious activity does not go on unattended by molecular changes in nerve tissue. It appears, therefore, that while in the vegetal world, and in the lower regions of the animal world, the life is purely or almost purely physico-chemical, it becomes more and more predominantly psychical as we ascend in the animal world, until at the summit it is mainly psychical. The continuous adjustment of inner to outer relations, which both constitutes life and maintains it from moment to moment, is a process which, at first purely physiological, becomes ever more distinctly psychological.

From the facts of comparative anatomy we may elicit a parallel truth. In standard works on human anatomy it is customary to distinguish between the *vegetative* organs (comprising the nutritive and reproductive systems), which are developed from the endoderm of the embryo, and the *animal* organs (comprising the nervo-muscular system), which are developed from the ectoderm. Not unfrequently these are

otherwise and more appropriately distinguished as the *nutritive* and *relational* systems — the special office of the former being the integration of nutritive material, in behoof either of the organism or of its derivative offspring, while the special office of the latter is the maintenance of relations between the organism and the environment. The demarcation is thoroughly distinct, but it is not absolute; since the relations each moment set up even in the nutritive system must correspond with certain general relations of air, temperature, and assimilable material in the environment. Now we have to note that in the vegetal world such general correspondences are all that are established; there is no system of organs differentiated for the purpose of maintaining an equilibrium of relations with the environment. In such simply organized animals as the polyp there is no differentiation of relational tissues or organs; but the entire surface of the animal, besides maintaining such general correspondences as characterize vegetal life, exhibits in a slight degree the irritability and contractility which in higher creatures are specialized in those tissues which form the relational organs. In the molluscoida, the property of irritability being localized in a few nerve threads uniting in ganglionic masses, and the property of contractility being specialized in a parallel manner, there is rendered possible that

more special mode of response to environing agencies known as reflex action. In the lower vertebrata the integration of numerous adjacent ganglia into a medulla, having connections with various parts of the organism, renders possible a much more perfectly coördinated series of responses to external stimuli. And at the same time the development of a pair of pedunculated ganglia from the upper portion of the medulla is attended by the ability to compound the impressions which the medulla receives; so that it becomes possible for the correspondences to extend in space and time. As we ascend through the vertebrate sub-kingdom, the growth of these pedunculated ganglia — the cerebrum and cerebellum — becomes more and more the predominant characteristic of the nervous system; and at the same time the power of adjusting inner relations to remote, special, and complex relations increases. Finally when we come to man, in whom the correspondences have reached a marvellous degree of heterogeneity, extent, and definiteness, we find not only that the relational system of organs is the dominant fact in his organization, but also that the system of pedunculated cephalic ganglia is the dominant fact in the relational system of organs. Not only is the nutritive life quite subordinated to the specially relational life, but the lower modes of the relational life, such as reflex action and instinct,

are quite subordinated to those higher modes, such as thought and emotion, which are made possible by the great extent to which the cerebrum and cerebellum carry the compounding of impressions received in the medulla. In order to realize with vividness how completely human life has come to mean the higher psychical life, let us try to imagine what life would be without the cerebrum and cerebellum. Yet from the biological point of view these systems of ganglia, though nearly, are not quite, absolutely essential to human life — since the less complex acts and impressions are still coördinated after they have been destroyed by disease, and since infants, born without any brain save the medulla and basal ganglia, have been known to live for a short time. Such a deprivation of the higher relational activities naturally seems to us almost equivalent to deprivation of life.

We may now more thoroughly appreciate the force of the distinction between the provinces of biology and of psychology, which was stated in the earlier part of this chapter. We see that while life, physical and psychical, is the continuous adjustment of inner to outer relations, nevertheless in the lowest forms of life, unaccompanied by mind, the outer relations to which adjustment is made are exceedingly general, and the correspondence is simple, direct, and homogeneous. But as we pass to forms

somewhat higher, we find, along with this simple correspondence maintained by the whole organism, a number of more complex, indirect, and special correspondences, for the establishment and maintenance of which there is differentiated a particular relational structure. As the correspondence increases in complexity, in indirectness, and in speciality, the maintenance of it is confined more and more to this specialized nervo-muscular structure — and the enormously heterogeneous series of adjustments which eventually goes on becomes distinguished from the relatively homogeneous series of adjustments which has all along been going on, as psychical life in contrast with physical life. Thus by a regular process of evolution it happens that, while at the outset the psychical life is but a slight extension of the correspondence which constitutes the physical life, at the end the correspondence which constitutes the psychical life is all in all, and the processes of physical life come to be regarded as entirely subordinate to the maintenance of this higher correspondence.

Let us now briefly trace the various extensions and complications of the correspondence as it becomes more heterogeneous, definite, and coherent. Scanty justice can here be done to the subject, since it is necessary for me to compress into half a dozen pages the substance of

a series of illustrations which in Mr. Spencer's exceedingly condensed exposition fill a hundred pages.[1] Nevertheless a few striking facts may be noted down, which will serve to assist in the comprehension of the process. Let us first note that in the simplest forms of life the correspondence extends "only to external relations which have one or both terms in contact with the organism. The processes going on in the yeast-plant cease unless its cell-wall is bathed by the saccharine and other matters on whose affinities they depend. . . . And so too among the lowest animals, the substances to be assimilated must come in collision with the organism before any correspondence between inner and outer changes is shown." The correspondence is similarly limited in time. The tree, which puts forth its leaves from year to year, does so only in response to luminous and thermal changes which occur contemporaneously. The polyp's tentacles contract only in response to immediately present stimuli. "Alike in all these forms of life, there is an absence of that correspondence between internal relations and *distant* external relations" — in space and time — which we see exhibited in higher forms.

Now the extension of the correspondence in space is effected by the gradual differentiation

[1] [See Part III. of vol. i. of the *Psychology*: "General Synthesis."]

of organs of sense. One of the most notable achievements of modern biology is the discovery — due among others, to Huschke, Remak, Milne-Edwards, and Huxley — that all the sense-organs are but successive modifications of tactile structures, or rather, of those simple dermal structures which in the higher organisms are specialized as tactile. The most perfect organs of touch are the *vibrissæ* or whiskers of the cat, which act as long levers in communicating impulses to the nerve fibres that terminate in clusters about the dermal sacs in which they are inserted. Yet these whiskers are merely specialized forms of just such hairs as those which cover the bodies of most mammals, and which are found evanescent upon the human skin, embedded in minute sacs or reëntrant folds. Now it is a demonstrated fact that the eye and ear are morphologically identical with *vibrissæ*. The bulb of the eye and the auditory chamber are nothing but extremely metamorphosed hair-sacs, and the same is true of the olfactory chamber. The crystalline lens is a differentiated hair, the aqueous and vitreous humours are liquefied dermal tissue, and the otolites of the ear are "concretions from the contents of an epidermic sac." In view of these astounding disclosures of embryology, we may readily assent to Mr. Spencer's statement that modern science justifies the guess of Demokritos, "that all the

senses are modifications of touch." From a single sense, more or less diffused over the surface of the body, and capable of establishing correspondences only with agencies in direct contact with the body, there have arisen, by slow differentiations, such localized senses as sight and hearing, which serve to enlarge the environment and establish correspondences with agencies more and more remote. Let us briefly consider the sense of sight, omitting hearing, as well as smell and taste, since our space is too limited to deal with them properly.

In such lowly organized creatures as the hydra the ability to distinguish between light and darkness, or between sunshine and shadow, is possessed in a slight degree by the entire surface of the body. But vision can hardly be said to exist, even in its most rudimentary aspect, until this sensibility is "concentrated in a particular spot. The rudimentary eye consisting, as in a planaria, of some pigment grains, may be considered as simply a part of the surface more irritable by light than the rest. Some idea of the impression it is fitted to receive may be formed by turning our closed eyes towards the light, and passing the hand backwards and forwards before them." But while this localization of sensibility enables the creature to adapt itself to the movements of neighbouring opaque bodies, the extension of the correspondence is

nevertheless very slight. To produce noticeable obscuration the opaque object must approach very near; and hence "we may infer that nascent vision extends to those objects alone which are just about to touch the organism, . . . so that it amounts at first to little more than anticipatory touch."[1] As we pass to higher forms, we find the eye gradually increasing in translucence, acquiring a convexity of surface, liquefying internally into refracting humours, while the nerve vesicles within multiply and arrange themselves as retinal rods; the result being seen in the gradually increasing power of the organism to adapt its actions to actions occurring at a distance. The process and the result of development are essentially the same in the case of hearing and smell, though there are great differences in the degrees to which these senses are developed in the highest animals.

Further extension of the correspondence is effected, in the higher vertebrates, by the increase in size and complexity of the cerebrum and cerebellum. These pedunculated groups of ganglia, which issue from the medulla, and whose function it is to compound in higher and higher aggregates the already compound impressions received by the medulla, are capa-

[1] Spencer, *Principles of Psychology*, vol. i. pp. 314, 315. [Part III. chapter iv. § 142.]

ble of adjusting inner relations to outer relations beyond the reach of the organs of sense. "Chased animals that make their way across the country to places of refuge out of view are obviously led by combinations of past and present impressions which enable them to transcend the sphere of the senses." And in man, by the aid of science, the correspondence is extended not only over the entire surface of the earth, but through all visible space; witness the facts that telegraphic reports enable purchasers in New York to adapt their actions to prices in London, and that the inferences of astronomers are modified in accordance with chemical changes going on in remote nebulæ.

Along with the extension of the correspondence in space there goes on an extension in time, resulting in an enormous increase of the psychical life. Under their more simple forms the two kinds of extension go on together. The rudimentary eye, which enables the organism to anticipate the contact of an approaching opaque body, may serve to illustrate the primitive connection between adjustments to external coexistences and adjustments to external sequences. And it is obvious, without concrete illustration, that in general the more remote are the outer relations to which inner relations are adjusted, the longer will be the interval by which the adjustment may be made to anticipate the group

of outer relations which it is designed to balance. But it is only in the higher vertebrates, whose cephalic ganglia are sufficiently large and complex to enable them to form ideal representations of outer relations not immediately present, that there is witnessed a decided extension of the correspondence in time. Dogs and foxes exhibit a well-marked anticipation of future events, in hiding food to be eaten hereafter. But it is first in the human race that such foresight becomes highly conspicuous; and the difference between civilized and savage men in this respect is probably even more marked than the difference between savage men and the higher allied mammals. There are strong reasons for believing that the more complex correspondences in time are chiefly effected by the cerebrum, while the more complex correspondences in space are chiefly affected by the cerebellum. And if this be the case, we may understand why it is that in the course of human progress the increase of the cerebrum in size and complexity has been so much greater than the increase of the cerebellum. In no other respect is civilized man so widely distinguished from the savage, as in his habitual adjustment of his daily actions to contingencies likely to arise in a more or less distant future. But here we touch upon an important theorem of sociology, which I shall hereafter consider at greater length.

Next let us note that the extension of the correspondence in space and in time is accompanied by a progressive increase in the speciality of the correspondence. Manifestly the differentiation of sense-organs which renders possible the adjustment of inner relations to distant outer relations, also renders possible the adjustment of inner relations to outer relations that are more and more special. Increased width of retina enhances the power of estimating the size of neighbouring objects, since the differences in the visual areas which they occupy will become more clearly appreciable. The multiplication of retinal rods enhances the power of estimating shape, since differently shaped objects affect different numbers and different combinations of these rods. Thus while animals with rudimentary vision, in becoming aware of the presence of approaching objects, can recognize them only as objects, on the other hand an animal with developed vision, in recognizing objects near or distant, can also distinguish between innumerable differences in their sizes and shapes, and can make a proportionally great number of special adaptations in its conduct. It is similar with the ability to distinguish colours, and to estimate direction by the eye. And from the growing heterogeneity of the other senses, we might draw parallel illustrations, were there room for them. Finally the high development of the

cephalic ganglia, rendering possible the compounding of ideal representations of objects and relations not present to sense, increases to an enormous degree the speciality of the adjustments. Such special adjustments are seen in the cases of "the lion that goes to the river-side at dusk to lie in wait for creatures coming to drink, and the house-dog standing outside the door in expectation that some one will presently open it." But the increase in speciality of adjustment is most conspicuously exemplified in the progress of the human race; as is seen by contrasting the savage who sharpens his arrows in expectation of the periodic flight of certain birds, with the astronomer who at a given day, hour, and minute adjusts his telescope to watch a transit of Venus.

In the life of the highest animals, and especially in the life of the human race, characterized as it is by the predominant activity of the great cephalic ganglia, there is witnessed an increase in the generality of the correspondence, parallel with the increase in speciality. As this topic falls almost entirely within the province of sociology, the illustration of it must be reserved for a future chapter. Let it here suffice to recall the fact, already mentioned (Part I. chapter viii.), that the progress of human knowledge has all along been equally characterized by analysis and by synthesis, — by the differentiation im-

plied in the recognition of relations that are more and more special, as well as by the integration implied in the grouping of relations in classes that are more and more general.

Along with the increase of the correspondence in spatial and temporal remoteness, in speciality and in generality, there is a continuous increase in complexity. Indeed, in the various aspects of psychical progress already contemplated, this aspect has been continually illustrated. Obviously the development of sense-organs, while widening the environment and increasing the number of relations to which the organism may adjust itself, enhances also the complexity of the adjustments. Contrast the simple movements of the planaria when an opaque object passes before its rudimentary eye, with the complex movements of a cat when a mouse is heard scratching in the wainscot, and it becomes evident that the heterogeneity of the impressions received by an organism is paralleled by the heterogeneity of the adjustments by which it responds to them. The multiplication of the objects and relations of which any organism can take cognizance involves of necessity a growing complexity in the actions by which it adapts itself to their presence. In civilized man, whose immensely developed cephalic ganglia bear witness to the predominance of psychical over physical life, this correlated advance in heterogene-

ity of correspondence is exemplified in the interdependent progress of science and art. Here again we are carried into the domain of sociology, and this thread must be left to be gathered up with the others when we come to treat of intellectual progress.

It remains to note that the extension of the correspondence in space and time, and its increase in definite heterogeneity, both heighten the degree of life and add to the ability to maintain life. On the one hand, the more numerous, the more complicated, and the more clearly defined are the outer relations to which the organism adapts itself, and the longer the interval of time by which the adjustments may be made to forestall external contingencies, the greater will be the number of heterogeneous changes in which life consists. And on the other hand, the greater the number of heterogeneous changes by which the organism can respond to outer changes, the more easily and surely will life be prolonged. Whence, says Mr. Spencer, "we may clearly see how life and ability to maintain life are two sides of the same fact — how life is a combination of processes, the result of whose workings is their own continuance." An interesting commentary on this proposition is furnished by Mr. Lankester's recently published essay on "Comparative Longevity," in which it is shown that high *individuation*, or the

power of responding heterogeneously to external changes, is the chief, though not the sole, factor concerned in producing length of life. The amount of normal longevity in any species depends upon the definite heterogeneity of the adaptation of its individual members to environing circumstances, and also upon the ratio of their nutrition to their expenditure. But the preponderant importance of the former factor is seen in the fact that, in spite of their immensely greater personal expenditure, the higher animals are, as a rule, very much longer lived than the lower ones. In the civilized human races also, as contrasted with the savage races, the life is not only higher in degree but longer in duration: the longevity of the lowest savages rarely exceeds forty-five years.

As we proceed to survey, in a single view, the various truths here separately elucidated, we find that the essential distinction, above insisted on, between the sciences of biology and psychology, is thoroughly justified by the very facts which illustrate the close connection between the two. The foregoing exposition conclusively proves that in dealing with the adjustments of inner to outer actions, biology "limits itself to the few in which the outer actions are those of agents in actual contact with the organism — food, aerated medium, and things which produce certain effects by touch (as insects which fertilize flow-

ers); thus leaving to psychology all other adjustments of inner to outer actions." "The moment we rose to a type of creature which adjusts certain organic relations to relations of which both terms are not presented to its surface, we passed into adjustments of the psychological order. As soon as there exists a rudimentary eye capable of receiving an impression from a moving object about to strike the organism, and on rendering it possible for the organism to make some adapted movement, there is shown the dawn of actions which we distinguish as intelligent. As soon as the organism, feebly sensitive to a jar or vibration propagated through its medium, contracts itself so as to be in less danger from the adjacent source of disturbance, we perceive a nascent form of the life classed as psychical. That is to say, whenever the correspondence exhibits some extension in space or in time, some increase of speciality or complexity, we find we have crossed the boundary between physical life and psychical life."[1]

[1] Spencer, *Principles of Psychology*, vol. i. p. 392. [Part III. chapter xi. § 175.]

CHAPTER XV

THE COMPOSITION OF MIND[1]

IN pursuing the analysis of a complex series of phenomena, with the object of ascertaining the simple ultimate elements of which the complex series is made up, we shall sometimes most satisfactorily accomplish our purpose if we begin with the most complicated cases which the series presents. After explaining these by resolving them into their less complex components, our analysis "must proceed similarly with these components; and so, by successive decompositions, must descend to the simpler and more general, reaching at last the simplest and most general." Let us proceed, after this fashion, to inquire into the Composition of Mind. Beginning with the most highly involved operations of conscious intelligence, and neglecting, for the time being, the consideration of those emotional states by which all operations of intelligence are to a greater or less degree accompanied, let us pursue our analysis until we have arrived at those ultimate units of feeling in the manifold compounding of which all con-

[1] [See Introduction, § 20.]

scious operations, whether intellectual or emotional, consist.

Beginning, then, with a somewhat complicated operation of intelligence, let us consider the process by which an astronomer, knowing the dimensions of the earth, is enabled to calculate therefrom the distance of the moon. He must, in the first place, assimilate in thought the case of the moon to like cases in which the distances of inaccessible objects upon the earth are indirectly measured. When a land surveyor wishes to ascertain the distance of a church tower situated on the farther side of a river, he has recourse to an indirect method of measurement. Upon his own side of the river he first measures the distance between two points sufficiently removed from each other, and this distance he calls a base line. From each end of the base line he now takes a sight at the inaccessible tower, and, with the proper instruments, measures the difference between its direction and the direction of the base line. In this way he obtains an ideal triangle, of which the tower is the apex; and, knowing the length of the base line, and the value of the two angles at the ends of the base line, he calculates by trigonometry the length of the two sides which express the distance of the tower from the ends of the base line. Now, the astronomer, imitating this process, assumes as a base line the known distance

between two remote points on the earth's surface, as for example London and Cape Town; and then from each of these points he proceeds to take the bearings of the moon. The process, indeed, is here complicated by the fact that, owing to the long distance, the inequalities of the earth's surface, and its curvature, the observer at Cape Town cannot see the position of London, and *vice versa*. It is necessary, therefore, again to resort to an indirect method, and, having measured the meridional bearings of the moon from the north pole at London and from the south pole at Cape Town, to compare these bearings with the knowledge that the bearing of the one pole from the other is 180 degrees or two right angles. A further correction must be made for the fact that London and Cape Town are not on the same meridian. But disregarding these steps in the process, as unnecessarily complicating our case, we have to note that, when the astronomer has thus indirectly measured the angles which ideal lines drawn to the moon must make at the two ends of his long base line from London to Cape Town, he is at once enabled, like the land surveyor, to calculate by trigonometry the lengths of these ideal lines, and thus to ascertain the moon's distance. What, now, is the essential characteristic of the process which the astronomer goes through? Or, in other words, what is the fundamental psy-

chical process by the manifold compounding of which is built up this highly complex series of inferences?

From beginning to end, the fundamental process is the cognition of the equality of sundry relations. The thought which underlies and determines the whole calculation is the cognition that the relations between the sides and angles of a great triangle, having for its apex the moon, and for its base the chord of the arc of the meridian of London measured to a point in the southern hemisphere upon the same parallel with Cape Town, are equal to the relations between the sides and angles of a similar small triangle, having an inaccessible tower for its apex and a measured line of five or six rods for its base; and that these relations, in turn, are equal to the relations between the sides and angles of a still smaller and similar triangle which may be drawn on a sheet of paper, and of which the sides and angles may, if necessary, be directly measured. Now, this cognition implies the previous establishment, in the calculator's mind, of sundry cognitions of the equalities and inequalities of certain relations between the sides and angles of triangles. To show briefly how such cognitions have been established, let us cite the simplest case — that in which the two angles at the base of an isosceles triangle are recognized as equal to each other. Euclid establishes this

point by supposing two similar and equal isosceles triangles, of which the one is turned over and placed upon the other, so that the apex and one side of the one will coincide with the apex and opposite side of the other. Then the other sides and the bases must respectively coincide, otherwise the two triangles would not be similar and equal, and the conditions of the case would be violated. All the sides being thus equal, each to each, the two triangles must everywhere coincide, and consequently the two basal angles must be equal, both in the triangle which has been turned over and in the one which has kept its original position. Now, each step of this demonstration is a cognition of the equality of a pair of relations of length or of direction; and in each case this cognition is established, not by any anterior demonstration, but by direct inspection. Or, in other words, when it is said that two lines of equal length, starting from the same point, and running in the same direction, must coincide at their farther extremities, the truth of the statement is at once recognized *simply because the states of consciousness which we call the ideas of the two lines are totally indistinguishable from each other.* This immediate perception of the equality — or, in some cases, of the inequality — between two or more relations of position or magnitude is the goal toward which every geometrical demonstration

tends. And, still more, it is the mental act implied in every step of every such demonstration. All the devices familiar to the reader of Euclid — the bisecting of lines and angles, the drawing of parallels and the circumscribing of circles for argumentative purposes — are simply devices for bringing a given pair of space relations directly into consciousness, so that their equality or inequality may be recognized by direct inspection.

Manifestly the case is the same in that algebraic reasoning which our astronomer will often find it desirable to employ in the course of his computation of the moon's distance. The axiom that "relations which are equal to the same relation are equal to each other" is an axiom which twice involves the immediate recognition of the equality of two given relations. And, if any proof were needed that the whole science of algebra is based upon this axiom, it may be found in one of the most common algebraic artifices. "When a simplification may be thereby achieved, it is usual to throw any two forms of an equation into a proportion — a procedure in which the equality of the relations is specifically asserted." To cite Mr. Spencer's simple illustration, — if we take any equation, $2xy=y^2$, and, dividing it by y, obtain a second equation, $2x=y$, the legitimacy of our proceeding is at once rendered apparent when the two equations are

thrown together in a proportion, in which it is asserted that the ratio of $2xy$ to y^2 is equal to the ratio of $2x$ to y. Or, if any doubt still remain as to the correctness of this, we resort to the familiar device of multiplying extremes and means, and obtain the identical proposition $2xy^2 = 2xy^2$, in which the identity of the two terms is immediately cognized, because the states of consciousness which they evoke are indistinguishable from one another.

Thus the complicated quantitative reasoning by which an astronomer determines the distance of a heavenly body consists in the long-continued compounding of immediate cognitions of the equality or inequality of two or more given relations or groups of relations of position and magnitude.

Before proceeding to unfold all that is implied by this conclusion, let us consider another concrete example of a somewhat different kind. When a certain horned animal, of slender figure, with cloven hoofs, and a hairy integument, is presented to the inspection of a naturalist, he at once recognizes it as a giraffe; and, if required further to describe it, he observes that, as having four stomachs and chewing the cud, it belongs to the sub-order of ruminants; as having its toes firmly united in a solid hoof, it belongs to the order of ungulata; as having mammary glands and suckling its young, it be-

longs to the class of mammals; and, as having an internal bony skeleton, it belongs to the sub-kingdom of vertebrates. What, now, is the mental act which is repeated at each stage of this description? It is "a cognition of the fact that the relation between particular attributes in this animal is like the relation between homologous attributes in certain other animals." To confine ourselves to the first clause of the description — "the attributes implied by the term *ruminant* can be known only as previously observed or described; and the predication of these, as possessed by the animal under remark, is the predication of attributes *like* certain before-known attributes. Once more, there is no assignable reason why, in this particular case, a relation of coexistence should be thought, between 'such attributes as the possession of four stomachs and the possession of horns and cloven hoofs,' unless as being *like* certain relations of coexistence previously known; and, whether the thinking of this relation can be otherwise accounted for or not, it is clear that the predication cannot otherwise have any probability, much less certainty."[1] The case is the same with the remaining clauses of the description. In each instance the mental operation performed by the naturalist is the recognition of the likeness be-

[1] Spencer, *Principles of Psychology*, vol. ii. p. 69. [Part VI. chapter vii. § 298.]

tween certain groups of relations observed in this giraffe and certain other groups of relations previously classified as pertaining to ruminants, ungulata, mammals, and vertebrates. Obviously, therefore, the reasoning by which the places of animals in the zoölogical scale are determined consists in the compounding of cognitions of likeness or unlikeness between certain given groups of relations.

So far, then, the mental operation performed by the naturalist seems to be not unlike that performed by the astronomer. And indeed, in spite of the superficial difference which seems so widely to separate the classification of animals from the measurement of celestial spaces, it will appear, on a moment's reflection, that the only real difference between the mental processes involved in the former case, and those involved in the latter, is the extent to which *likeness* is predicated of the relations concerned. Deeply considered, the act of the astronomer is the same as that of the naturalist, — save that, while the former classifies together sundry groups of relations as *equal* to one another, or indistinguishable from one another, the latter classifies together sundry groups of relations as *like* one another, or but slightly distinguishable from one another. Now, in this statement we see that what is meant by *equality* is merely *exact likeness;* but something more is

needed for the accurate description of the difference between the two cases. The objects which the astronomer contemplates are simple triangles, presenting simple relations of position and magnitude; while the objects contemplated by the naturalist are complex organisms, presenting immensely compounded relations of structure and function. Now, in speaking of simple things or simple relations, such as lengths and breadths, weights, times, and velocities, we habitually predicate *equality* or *inequality* of them. "Wherever the terms of the comparison, being both elementary, have only one aspect under which they can be regarded, and can be specifically posited as either distinguishable or indistinguishable, we call them either *unequal* or *equal.* But when we pass to complex things, exhibiting at once the attributes, size, form, colour, weight, texture, hardness, — things which, if equal in some particulars, are rarely equal in all, and therefore rarely indistinguishable,—then we use the term *like* to express, partly the approximate equality of the several attributes separately considered, and partly the grouping of them in a parallel manner in time and space. Similarly with the relations involved in reasoning. If simple, they are recognized as *equal* or *unequal;* if complex, as *like* or *unlike.*"

The essential difference, then, between the quantitative reasoning employed in the most

advanced sciences, and the qualitative reasoning employed in those which are less advanced, may be thus stated: in the first case the relations contemplated are so simple that they may be directly juxtaposed in consciousness, and recognized as *equal* or *unequal;* but in the second case the relations contemplated consist of so many simple relations heterogeneously combined, that they can only through a very indirect process be juxtaposed in consciousness, and hence are only approximately recognized as *like* or *unlike.* That this is the only essential difference between quantitative reasoning and qualitive reasoning is shown by the fact that all qualitative reasoning is vaguely quantitative, while all quantitative reasoning begins by being qualitative. For example — to cite Mr. Spencer's admirable illustration — when a brewer describes a vat of fermenting wort as containing carbonic acid, he makes a qualitative statement; yet some rude notion of quantity is involved in it. "He thinks of the carbonic acid as more, certainly, than a cubic foot; less, certainly, than the total capacity of the vat: the quantity is thought of as in some ratio to the quantity of wort." On the other hand, "a man who has walked a mile in fifteen minutes, and, observing that he has a quarter of a mile still to go, infers the time it will take to reach his destination, does not primarily infer *three minutes and*

three quarters; he primarily infers *a short time* — a time indefinitely conceived as certainly less than ten minutes, and certainly more than one." Doubtless he may in an instant proceed to calculate the exact length of the time; yet, as it will not be denied that even before calculating he has a vague notion of the interval, it must be admitted that his inference, though ultimately quantitative, is, at the outset, only qualitative. Between the two kinds of reasoning, therefore, the only difference is the degree of definiteness to which they are respectively developed.

Bearing in mind these mutually harmonious conclusions — which alike imply the assertion that, between the highest and the lowest kinds of reasoning employed by civilized man, the difference consists solely in the complexity of the relations contemplated, and in the greater or less definiteness with which these relations are cognized as equal or unequal, like or unlike — let us now advance a step farther. Already, in the course of the foregoing analysis, the essential similarity between reasoning and classification has been vividly brought before us. We have now to scrutinize this similarity somewhat more closely.

To cite an example with which we are already familiar: when our astronomer, some thirty years ago, observed that certain irregularities in the motions of Uranus still remained un-

accounted for, after calculating the combined effects of all the interior planets in producing such irregularities, it occurred to him that the unexplained irregularities could only be due to the gravitative force of some undiscovered planet outside of Uranus; and the discovery of Neptune was the result of this most brilliant hypothesis. Now, the mental act involved in this deduction was essentially a *classification of cases*. The case of the unexplained perturbations was mentally ranked along with the several cases of explained perturbations presented by the solar system, as being similarly due to gravitative force; and to the number of known cases in which planets deflect each other from the regular paths in which they would otherwise move, a new hypothetical case was added. Comparing, now, this mental operation with that of the naturalist who, by virtue of certain observed likenesses of structure and function, ranks together lions and elephants and seals in the class of mammals, we may conclude roughly that the one process consists in the formation of a group of *like cases*, while the other consists in the formation of a group of *like things*. And since by the expression "like cases" we mean merely "like sets of relations among two or more given groups of things," it follows that we may characterize Reasoning as the *classification of relations*, while Classification,

ordinarily so called, is the *classification of things.* When, for example, on perceiving two similar triangles set side by side, we proceed to make some inference from the known value of a side in the one to the desired value of the corresponding side in the other, the act is an act of reasoning. But when, on taking up two similar seashells, we recognize them in their totality as belonging to an oyster or some other familiar mollusk, the act is an act of classification, commonly so called. In other words, if the perception of similarity is followed by the thought of one or more of the like relations which make up similarity, we have an act of reasoning; but if it is followed by the thought of other objects presenting like relations of similarity to the one now perceived, we have an act of classification.

But closely related as these two mental operations are now seen to be, we have not yet disclosed the full extent to which they are related. Not only is classification involved in every act of reasoning or inference, but reasoning or inference is involved in every act of classification. Not only does reasoning consist in the grouping of relations as like or unlike, but the classification of things can go on only through the grouping of relations as like or unlike. To illustrate this, let us take a further downward step, and consider a mental operation apparently much simpler than those hitherto

treated. Let us consider what is implied by the perception of an object.

It is admitted on all sides that the perception of an object necessarily implies the *recognition* of the object as this or that, as like certain objects, and as unlike certain other objects. Every act of perception, therefore, involves classification. We cannot even name a chair without implying the existence of a group of objects which the chair resembles; and the essential element in the perception of a chair is not the reception of a group of visual or tactual impressions, but the interpretation of these impressions as like other antecedent impressions which, taken together, constitute the consciousness of the presence of a chair. And this is as much an act of classification as the act by virtue of which the naturalist would rank a newly found horned and cloven-hoofed mammal among the ruminants; the only difference being that in ordinary perception the act has been performed so frequently as to have become automatic at an early period of life, while in scientific classification the act involves more or less conscious thinking, and comparison of relations.

Here, in this last clause, there is hinted what we are seeking for. Not only in scientific classification, but in ordinary perception also, there must go on a comparison of relations, and a

grouping of them as like or unlike. In perceiving an apple, for example, "the bulk is perceived to be like the bulk of apples in general; the form like their forms; the colour like their colours; the surface like their surfaces; and so on." For if the bulk were like that of a watermelon, or if the shape were cubical, or if the colour were inky black, or if the surface were covered with thorns, the object would not be perceived to be an apple. The act of perception, therefore, consists in the recognition of sundry attributes as like sundry attributes previously known, and as having relations to one another like the relations between the before-known attributes. This will appear still more clearly when we recollect what takes place in visual perception. It is well known that the eye, unassisted by the muscular and tactual senses, can take no cognizance of distance, shape, or solidity — the only impressions which the retina receives are impressions of colour, and indirectly of superficial extension. It is because of this that infants reach out for the moon, and that blind men, on first receiving sight, are unable to distinguish between a round orange and a cubical block, without feeling the surfaces of the two. Only after repeated and careful comparison of visual impressions with muscular and tactual impressions is the patient enabled to discover, by the eye alone, that all the objects

in the room or in the landscape are not in contact with his body; and it is only after a similar elaborate comparison that the young child achieves the feat of looking at an object in a given direction, or of recognizing by vision its father or mother. Accordingly, when looking about the room, all that you really *see* is a congeries of coloured spots. Your knowledge of the presence of divers objects — chairs, windows, mirror, mantelpiece — is not given in the act of vision, but is the result of an exceedingly complex, though apparently instantaneous, process of reasoning. Your seemingly immediate knowledge that a certain group of coloured spots means a chair is due to the fact that from early infancy this group of coloured spots, or some other like group, has been associated with sundry impressions of touch and resistance, and with sensations yielded by the little muscles which turn the eye hither and thither. The frequency with which the association has been repeated has rendered the process of inference automatic, just as, to a less-marked extent, the process of reading, at first accompanied by a conscious classification of every letter, has become automatic, so that we are not aware of cognizing the letters at all. Nevertheless, although too rapid to rise into consciousness, the process is still one of inference, implying, like any other process of inference, the grouping of

certain relations as like or unlike certain other relations. Certain correlated groups of colours are automatically classified with other correlated groups of colours previously received upon the retina, and also with certain correlated groups of muscular and tactual impressions, previously received simultaneously with the groups of colours in question. Thus our visual perception of objects consists of a group of sensations *plus* a complicated series of inferences which does not differ fundamentally from a course of scientific demonstration. And the same truth may be, with equal justice, though less vividly, illustrated in the case of any other sense than sight. A much simpler case than that of visual perception is that of a spoon, containing some unknown liquid, thrust into the mouth by another person in the dark. Here the only clew to the character of the liquid is its taste; and when, by its peculiar mild pungency, the liquid is recognized as bromide of potassium, the psychical process consists of a gustatory sensation *plus* an act of classification by which the sensation is grouped, with other like sensations previously received. The example is a good one, as showing us also the obverse case. If bromide of potassium has not been previously tasted, the result is simply gustatory sensation unattended by perception; or rather, it is gustatory sensation generically classified as mildly pungent,

but not specifically referred to any known liquid, and therefore only partially interpreted. There is perception, but it is incomplete.

It is not pretended that these psychological truths are established by the crude and fragmentary exposition here given. The numerous observations and experiments upon which they are based would be very interesting to recount; but our space does not admit of detailed proof, nor is it needed; since these truths are the common property of psychologists, and will be questioned by no competent student of the phenomena of mind. Referring, for minute and elaborate proof, to Mr. Spencer's "Principles of Psychology," let us be content with setting down the implication which is common to all these conclusions; namely, that between the various psychical processes thus far contemplated, which include alike the measurement of celestial distances by the astronomer, and the direct perception of objects by the unlearned child, or indeed by the ape or dog, there is generic identity. The fundamental characteristic which is common to them all is the reception of certain groups of sensations, accompanied by the classification of these groups of sensations, and of the relations between them, according to their various likenesses and unlikenesses. The difference between the highest and the lowest of the processes thus brought together con-

sists solely in the heterogeneity and definiteness of the groups which are classified, and in the extent to which the classifications are compounded.

To such a statement, however, there is one essential qualification to be added. It is not strictly correct to say that the classification involved alike in the most complex act of reasoning and in the simplest act of perception is a classification of groups of *sensations* and of the relations between them. For when an object is perceived, along with the sensations actually present, there are remembered or internally revived sensations which enter into the classification, and these internally revived sensations are what we call ideas or images. For example, "when passing the finger over a rough surface, the perception contains very much more than the coördinated sensations immediately experienced. Along with these there go the remembered visual impressions produced by such a surface, which cannot be kept out of the mind, and in the suggestion of which the perception largely consists; and there are automatic inferences respecting the texture and density of the substance." So when we see an orange lying on the table, the only sensation actually present and entering into the case is the sensation of a patch of reddish-yellow colour surrounded by other unlike patches of colour.

The other elements in the classification of which the perception consists are ideas or internally revived sensations of position, shape, bulk, texture, juiciness, and so on. And now we discover another point of difference in degree between perception and reasoning. While in perception some of the elements classified must be sensations actually present, in reasoning *all* the elements classified may be ideas or internally revived sensations. The sides and angles of the isosceles triangles which the astronomer compares in estimating the moon's distance are ideal sides and angles; and the naturalist, in writing about the classification of ruminants, deals solely with internally revived impressions of horns, hoofs, and multiple stomachs, which were previously present to sense. Thus the classification involved in reasoning differs from that involved in perception, not only in heterogeneity and definiteness, but also in *indirectness*. Nevertheless the difference is not fundamental, but is only a difference in degree; as is proved by the fact that alike in reasoning and in perception there is implied the previous reception of the actually present sensations of which the ideas or revived sensations are the copies. Our statement, therefore, will become strictly correct if we say that the fundamental characteristic common to the most refined reasoning, and the crudest perception, is the pre-

sence of certain *states of consciousness*, accompanied by the classification of these states and of the relations between them according to their various likenesses and unlikenesses; the differences between the processes being differences in heterogeneity, definiteness, indirectness, and extent of integration or compounding.

Let us next observe that, as between the highest and lowest kinds of reasoning there is a great difference in the extent to which the comparison of relations is carried, so between the highest and lowest kinds of perception there is a similar difference.

There is a striking contrast in degree of directness "between the perception that some surface touched by the finger is hard, and the perception that a building at which we are looking is a cathedral. The one piece of knowledge is almost immediate. The other is mediate in a double, a triple, a quadruple, and even in a still higher degree. It is mediate inasmuch as the solidity of that which causes the visual impression is inferential; mediate inasmuch as its position, its size, its shape, are inferential; mediate inasmuch as its material, its hollowness, are inferential; mediate inasmuch as its ecclesiastical purpose is an inference from these inferences; and mediate inasmuch as the identification of it as a particular cathedral is a still more remote inference resulting from the union of

these inferences with those many others through which the locality is recognized."[1] From this example it appears that while, at the highest extreme, perception emerges into reasoning, on the other hand at its lowest extreme, as where a body is perceived to be rough or hard, it borders very closely upon simple sensation. Proceeding then a step farther in our descending analysis, we have to examine the character of the difference between perception and sensation.

Sensation, no less than perception, has a variety of grades. At the one extreme it rises to a point where it is barely distinguishable from perception; at the other extreme it lapses into an unconscious or sub-conscious psychical state. While writing these lines the sum total of my consciousness may contain elements contributed by dull sounds of persons walking overhead, by the rumbling of wagons in the street, by faint odours wafted from the kitchen, by soothing pulses of sensation from the pipe held in my mouth, and by the occasional striking of the cuckoo-clock, as well as by the pressure exerted by the chair in which I am sitting, and the table upon which my arm is resting, and the pen which is grasped in my fingers. But while I am absorbed in thought, none of these

[1] Spencer, *Principles of Psychology*, vol. ii. p. 245. [Part VI. chapter xviii. § 352.]

elements rise into the foreground of consciousness, — though they are present as psychical states, as is shown by the fact that the going out of the pipe or the failure of the clock to strike is noticed; yet I become *conscious* of them, in the ordinary sense of the word, "only when they pass a certain degree of intensity," as when a child overhead falls on the floor, or when the shriek and rumble of a passing railway train are added to the confused mass of outdoor noises; "and only then can I be said to experience" these feelings "as sensations." But when a psychical state rises into the foreground of consciousness and becomes known as a sensation, as when my finger happens to touch the heated pipe-bowl, then "I not only contemplate the affection as an affection of myself — as a state through which my consciousness is passing or has passed — but I also contemplate it as existing in a certain part of my body — as standing in certain relations of position. I perceive *where* it is." The close relationship between sensation and perception is illustrated by this example: nevertheless psychology here distinguishes between two portions of the mental act. Though in the practical experience there is no separation between the two, yet analysis enables us to distinguish between the consciousness of the painful feeling and the consciousness of the presence of the heated object which causes

the feeling; and the former of these we call sensation, while the latter we call perception.

We shall now be greatly assisted by observing a psychological fact of which Sir William Hamilton caught a glimpse, though, as usual, his analysis was not sufficiently thorough, and his statement of the case was inaccurate. We need not pause to criticise the theorem that while "perception proper and sensation proper exist only as they coexist, in the degree or intensity of their existence they are always found in an inverse ratio to each other;" for its inaccuracy has been fully demonstrated by Mr. Mill and also by Mr. Spencer, who shows the true statement to be, "not that sensation and perception vary inversely, but that they exclude each other with degrees of stringency which vary inversely." To illustrate this, we will suppose that you are getting water from a hot-water faucet, and that, as the water begins by running cold, you clasp your hand about the faucet so as to turn it off when the water has become sufficiently warm. While the water is cool or tepid, sensation is at the minimum, and not only is there no exclusion of perception, but consciousness is occupied with the outer phenomena, the faucet and the running water, more than with the inner phenomenon, the feeling of temperature. The pointed end of the upright part of the faucet, and the protuberance

where the horizontal piece is fitted upon it, awaken tactual sensations which coexist with the sensation of temperature, and the automatic comparison of these sensations which constitutes the perception of the faucet goes on unhindered. To concentrate consciousness upon the feeling of temperature requires a voluntary act of attention, induced by the desire to know how warm the water is getting. As the water becomes very much warmer, so as to be slightly uncomfortable, the perception of the faucet does not become gradually less vivid, but it tends to disappear entirely, and consciousness tends to occupy itself exclusively with the feeling of temperature. Only through a distinct voluntary effort can the perception be made to come into the foreground of consciousness. If now there comes a sudden spurt of very hot water, the tactual perception of the faucet is for the moment entirely excluded, and the perceptive act implied in the estimation of the degree of temperature is also expelled from consciousness, which is occupied entirely with the sensation of pain, inducing a violent withdrawal of the hand. Here sensation, reaching a maximum, has quite driven out the group of tactual perceptions, and even visual perceptions are to that extent held in abeyance, that for the moment they cease to occupy the attention. If now a piece of soap is taken from its dish, the newly aroused

group of sensations, of weight, hardness, smoothness, and the rest, exist in minimum intensity; and consciousness is occupied, not with them, but with the presence of the piece of soap: perception tends to exclude sensation.

"What, now," inquires Mr. Spencer, "is the real nature of this mutual exclusion? Is it not an instance of the general fact that consciousness cannot be in two equally distinct states at the same time; and that in proportion as the predominance of one state becomes more marked, the suppression of other states becomes more decided? I cannot know that I have a sensation without, for the moment, having my attention specially occupied with that sensation. I cannot know the external thing causing it, without, for the moment, having my attention specially occupied with that external thing. As either cognition rises, the other ceases." By the "external thing," Mr. Spencer does not here mean the *Ding an sich*, but the group of phenomena which are referred to an existence outside of the organism. But we have already seen that, when consciousness is so occupied with such a group of phenomena that the result is the perception of an object, the psychical act involved is an automatic classification of sundry states of consciousness and of the relations between them, according to their various likenesses and unlikenesses. Thus we arrive at the

distinction between sensation and perception. Impossible as it is to disentangle the two in practical experience, analysis yet distinguishes the former as an apparently elementary state of consciousness, while the latter is "a discerning of the relations between states of consciousness." According, therefore, as attention is directed chiefly to a conscious feeling or to the relations between a number of feelings, is now sensation and then perception predominant.

It remains to be observed that sensations, or — as we may otherwise call them — feelings, are either peripherally or centrally initiated. In other words, a feeling may either originate at the surface of the organism — as is the case with sensations of sight, hearing, smell, taste, and touch, and in the main with muscular and thermal sensations; or it may originate in the interior of the organism — as is the case with the sensations of hunger and repletion, and with certain muscular sensations, such as cramp; or, again, it may start from some group of nerve centres, as is the case with those vague feelings which accompany more or less complex acts of perception and reasoning, and which, when they acquire a certain degree of prominence, we call emotions. By the inclusion of these states of consciousness, the term "feeling" covers a somewhat wider range of meaning than the term "sensation." Nevertheless the current use

of the word "feeling" to designate indifferently a sensation or an emotion bears unconscious witness to the fact that the two kinds of psychical state differ only in their modes of genesis and of composition. The contrast between a peripheral sensation, as of colour or touch, and an emotion, is chiefly a contrast in degree of definiteness and of localization. But this contrast holds also between peripheral sensations and such vague internal sensations as hunger, which, being known as cravings, are assimilated to the lowest orders of emotion. From this difference in definiteness arises the fact that the peripheral sensations admit of being definitely grouped according to their relations of likeness and unlikeness, and thus afford the material for perception and reasoning, while emotional states admit no such definite grouping, but arrange themselves variously in clusters, the particular character of the cluster being determined by certain contemporaneous perceptions or ideal reproductions of past perceptions. For these reasons the ultimate psychological nature of emotion can be reached only through a synthetical interpretation which starts by recognizing the fact that, along with that classifying of conscious states which occurs in perception and reasoning, there goes on a recognition of certain states as pleasurable or desirable to retain in consciousness, and a re-

cognition of certain other states as painful or desirable to expel from consciousness. Thus in practical experience emotions are, in however slight a degree, inseparably associated with perceptions and inferences, as the vague, internally initiated feelings accompanying the definite peripheral feelings in the classifying of which the perceptions and inferences consist.

Looking back now over the region already traversed, we find that we have passed in review a large number of mental operations which differ immensely in complexity, some of them being performed only by the most highly educated adult civilized men, while others are performed habitually by children, barbarians, and numerous animals inferior to man. Yet, amid all this diversity, our analysis has detected a fundamental unity. In spite of their vast differences in complexity, we have seen that all these mental operations are ultimately made up of the same psychical process. The grouping of the relations among feelings is the elementary act which is repeated alike in each simple and direct act of perception, and in each complicated and indirect act of ratiocination. At the present stage of our analysis, therefore, the ultimate elements of mind would seem to be *feelings* and the *relations between feelings*. It remains to add that relations themselves must be secondary feelings due to the bringing together of primary feelings.

We can know a relation only as some modification of consciousness resulting from some combination of the feelings directly aroused in us by inner or outer agencies; and such modification of consciousness must be itself a kind of feeling. For further illustration let us briefly mention the different relations in the order of their decreasing complexity, that we may note the fundamental relation involved in them all. The most complex relations are those of *similarity* and *dissimilarity*, as exemplified when we recognize the kinship between a thoroughbred racehorse and a Shetland pony, or the complicated divergences between a city and a village. Simpler relations are those of *cointension* and *non-cointension*, as when we perceive that two sounds are equal in degree of loudness, or that in grasping wood and in grasping marble the feelings of temperature are different in degree; of *coextension* and *non-coextension*, as when two lines or two areas are seen to be equal or unequal; of *coexistence* and *non-coexistence*, as when the yellow-reddish light reflected by an orange is regarded as accompanied by sweetness and juiciness, but not by viscidity; of *connature* and *non-connature*, as when greater warmth is mentally assimilated to less warmth, but distinguished from blueness or roughness. Now, underlying all these relations, and all mental processes whatever, is the relation of *likeness*

and *unlikeness* between primary states of consciousness. Given the power of recognizing two feelings or conscious states as like each other, and two other feelings or conscious states as unlike each other, and we have the primordial process in the manifold compounding of which all operations of intelligence consist. Let us now take into the account the universally admitted fact that consciousness is rendered possible only by ceaseless change of state — that a uniform state of consciousness is in no respect different from complete unconsciousness. If our minds were to become spellbound, like the palace of the Sleeping Beauty, all our thoughts and feelings remaining fixed *in statu quo*, our conscious existence would be practically at an end. For consciousness to exist at all, it is necessary that a given state should be followed by a different state. But this is not all that is required. A succession of feelings, of which no two were alike, would not give rise to consciousness, since the recognition of any feeling implies its classification with some antecedent like feeling. Consciousness, therefore, " is not simply a succession of changes, but an *orderly* succession of changes — a succession of changes *combined and arranged* in special ways." Thus we reach the law of the Composition of Mind. Since intelligence cannot arise or continue unless consciousness is continually passing from one state into a differ-

ent state, it follows that there must be a continuous *differentiation* of states; and again, since intelligence cannot arise or continue unless particular states of consciousness are continually known as like certain previous states, it follows that there must be a continuous *integration* of states. Alike in the most rudimentary perception and in the most developed reasoning, the essential process is the separation of the unlike and the bringing together of the like. So that, "under its most general aspect, all mental action whatever is definable as *the continuous differentiation and integration of states of consciousness*," and the kind of mental action is regarded as high or low, according to the greater or less extent to which the differentiation and integration are carried. The phenomena of conscious intelligence are thus seen to conform to the universal law of evolution; and we may further note that this conclusion is entirely in harmony with the definition of psychical life as the continuous adjustment of inner to outer relations. For clearly, when an intelligence is developing in the midst of a complex environment, the greater the number of subjective relations which are adjusted to objective relations, the greater will be the extent to which the differentiation and integration of conscious states will be carried.

Here we may seem to have arrived at a satisfactory conclusion of our analysis. But the

lowest depths of the problem yet remain to be sounded, as will be seen when we consider a superficial objection not unfrequently urged against the foregoing views. Alike in all the mental operations which have formed the subject matter of our analysis, we have seen that the relations of likeness and unlikeness entering into the case are classified with certain other relations of likeness and unlikeness previously cognized. The thought which determines the astronomer in calculating the moon's distance implies previous experience of triangles and of numerical relations. In the classification of a giraffe there is implied previous acquaintance with the complex relations of structure and function connoted by the terms *ruminant*, *ungulate*, *monodelphian*, *mammal*, *vertebrate*, and *animal*. The perception of an apple implies numerous antecedent experiences of colour, size, configuration, smoothness, odour, and taste. And in like manner, though we have provisionally defined a sensation as an "elementary state of consciousness," yet we have also seen that, in order to become truly conscious of a sensation, we must know it, or, in other words, must classify it with some like sensation previously felt. In short, we have seen that there can be no *cognition*, of whatever order, which is not a *recognition*, necessarily implying some previous combination of psychical states. How then, it

is asked, can there be any first cognition? How can intelligence ever begin at all, if the first and simplest intelligent act implies a reference to experiences which, in accordance with the theory, must have preceded any intelligent act?

Formidable as this objection may seem, and unanswerable as it would have been if urged half a century ago, it has to-day no force whatever; and those who now deliberately urge it succeed only in betraying their entire lack of acquaintance with the progress which psychology has made since the times of Reid and Stewart. As long as psychological questions were settled simply by introspection — by observing what goes on in the consciousness of adult civilized man — the objection here cited must have seemed conclusive. But familiarity with the conception of evolution has now led us to regard things in general, not as coming at once into fulness of being, but as gradually beginning to be; and in the case of the phenomena of intelligence, this view of the question is amply justified by experiments in objective psychology presently to be mentioned. The conception of an absolutely first cognition, not determined by previous psychical states, rests upon a fallacy similar to that upon which rested the preformation theory in biology. Just as it was formerly held that the embryo started as a fully developed organism, differing from an adult organ-

ism only in size, so the objection which we are now considering involves the hypothesis that the earliest cognitions of an infant are like those of an adult in point of definiteness, the only difference being in the quantity of them. The latter hypothesis is as contrary as the former to the Doctrine of Evolution, and it is quite as decidedly negatived by the observation of facts. For let us observe what is implied by the acquiring of a definite cognition by an infant. If the foregoing analysis be taken as correct, it is obvious that when any object, as an orange, is first presented to the mind of an infant, it cannot be perceived or identified as an orange. Before this intellectual feat can be achieved, there must go on for some time that complicated grouping of visual, tactual, and gustatory sensations above described. In accordance with the established theory of vision, we must admit that, when the orange is held before the child's eye, the only sensation aroused is that of a reddish-yellow colour, which cannot even be perceived to be round until after it has been associated with sundry tactual sensations. But this is not all. Not even the sensation of a reddish-yellow colour can acquire definite shape in consciousness, until sensations of blue, or red, or green, or white colour have been aroused, with which it can be contrasted, and until a subsequent like sensation of reddish-yellow colour

has been aroused to which it can be assimilated. Observe now the position into which we are brought. We are obliged to hold that the first sensation of orange colour cannot, strictly speaking, exist as a sensation at all; while, nevertheless, a subsequent sensation of orange colour (not, in any actual case, the second, but the twentieth or hundredth) occurring after intervening sensations of blue or green, can acquire definite shape as a sensation by being compared with this first sensation which is not strictly a sensation. Obviously then, though the first presentation of orange colour cannot awaken a visual sensation which can be known as such, it must produce some psychical state which is real, though not known. For if no psychical state were produced by the first presentation, then the second, or twentieth, or hundredth presentation could no more awaken a definite state of consciousness than the first. We are thus led to the assertion that states of consciousness may be produced by the differential grouping or compounding of psychical states which are beneath consciousness.

Now this conclusion, which admirably explains the beginnings of conscious intelligence in the young child, is completely confirmed by experiments lately made with reference to the continuous genesis of sensations in the adult. Not only does the infant frame its earliest con-

scious sensations by the compounding of unconscious or sub-conscious psychical changes, but in every sensation of sound, colour, odour, taste or touch which the adult receives, there is a precisely similar formation of a conscious state by the compounding of unconscious or sub-conscious psychical states. In the case of sound, the evidence for this statement amounts to complete demonstration; the evidence is hardly less strong in the case of sight; and in the case of the other senses, all the evidence thus far obtained points toward the same conclusion. Let us first examine the composition of a sensation of sound, as admirably elucidated by M. Taine in his recent treatise on "Intelligence."

In musical sounds three characteristics are to be distinguished — loudness, pitch, and quality or *timbre*. The first of these, the loudness, depends upon the amplitude of the atmospheric waves by which the sensation of sound is caused. A series of sound-producing waves, like any other series of waves, has its elevations and depressions, and the height of the elevation above the depression is called the *amplitude* of the wave. The loudness of the sound varies as the square of the wave's amplitude. From this it follows that every elementary sound has a period of minimum intensity, answering to the wave's minimum amplitude when it is just beginning to rise; secondly, a period of maximum inten-

sity answering to the wave's maximum amplitude when it has risen to its greatest height; and, thirdly, a period of minimum intensity, answering to the wave's minimum amplitude when it has sunk nearly to the level again; while between these minima and the maximum there are many varying degrees of loudness. In other words, every elementary sound is at first faint, then gradually becomes loud, then grows fainter, till it disappears. Now note what happens when elementary sounds are made to succeed each other. If the succession be irregular, there is a mere chaos of noises — a case with which we need not here deal. But if the succession be regular, and steadily increase in rapidity, there follows a remarkable series of results. As long as the waves or pulses answering to the elementary sounds succeed each other slowly, the sounds are distinguishable from each other as raps or puffs, according to the instrument employed, and each has its maximum and its two minima of intensity. But when the waves begin to strike the ear at the rate of about sixteen in a second, the consciousness of separate raps or puffs becomes evanescent, and there arises the consciousness of a continuous tone of very low pitch. That the consciousness of the separate sounds has not quite ceased, and that the continuousness of the tone which they compose is not complete, are shown by the fact that the

maxima and minima are still perceived. In the deepest bass notes of an organ, for example, the pulsations are clearly distinguishable — a fact which proves that we are conscious of the effects answering respectively to the protuberances and to the hollows of the waves. Now, the pitch of a tone depends upon the rapidity with which the waves succeed each other, and, therefore, upon their length, or the distance between two successive hollows, because as the waves come faster they grow shorter. The shorter the waves, the higher the pitch. Hence, as the pitch rises, the protuberance of any wave approaches nearer and nearer to the protuberances of the waves immediately behind it and in front of it, and the maximum intensities of sound which answer to the protuberances become crowded together in consciousness. The result is that, after a while, the maxima and minima are no longer distinguishable by the ear, so that by no effort of attention can we discern the elementary pulses of which the tone is composed. The tone asserts itself to be completely homogeneous. All that mere introspection could discover in consciousness would be an apparently simple sensation of musical tone. Yet into the composition of this sensation there enter a thousand or several thousand psychical states, answering to the presence of as many elementary sounds with their maxima and minima

of intensity. And if any one of these elementary sub-conscious psychical states were absent, the character of the conscious sensation would be different from what it is.

But this is not all. Every musical tone has a *timbre* or quality of its own, according as it proceeds from a piano, a violin, a flute, or any other instrument. Now, Helmholtz has proved that the quality of any tone is due solely to the number and combinations of certain higher and fainter tones which accompany it. Along with the fundamental note there are heard sundry harmonic notes, due to vibrations from two to ten times more rapid than those which constitute the fundamental note. When any note is sounded on the piano, the first six harmonics are sounded with it; when the same note is sounded on the violin, by means of the bow, the first six harmonics are sounded so feebly as to be overpowered by the seventh, eighth, ninth, and tenth; and this is the only cause of the difference in quality of tone between the piano and the violin. Now, by an effort of attention these harmonic over-tones may be recognized as distinct sensations when two or three notes are slowly struck. But in ordinarily rapid playing they are not distinctly recognized. Their only effect is to impart to the tones that peculiar quality which enables the ear to recognize the instrument from which they

emanate. Thus our apparently simple sensations of musical sound are enormously complex. When F-*in-alt* is sounded on the violin, there are produced, in the course of a single second, several thousand psychical states which together make up the sensation of pitch, fifty-five times as many psychical states which together make up the sensation of quality, and an immense number of other psychical states which together make up the sensation of intensity. These psychical states are not, in any strict sense of the term, states of consciousness; for if they were to rise individually into consciousness, the result would be an immense multitude of sensations, and not a single homogeneous sensation. There is no alternative, therefore, but to conclude that in this case a seemingly simple state of consciousness is in reality compounded of an immense multitude of sub-conscious psychical changes.

Returning now to what we have called the elementary sound, by the manifold compounding of which all cognizable tones, qualities, and intensities are built up, we shall the more readily yield to the evidence which shows that even this primitive unit of sound is not elementary. For as M. Taine observes, each so-called elementary sound, in passing from its minimum to its maximum, passes through an infinite series of degrees of intensity, and, unless there were

some psychical modification corresponding to each increment of intensity, there would be no state of consciousness answering to the total rise from the minimum to the maximum. Again, while, for simplicity's sake, we have assumed that each of the raps or puffs which occur too slowly to be heard as a single tone of lowest pitch is heard by itself as an elementary sensation, this is not strictly true. For the so-called simple sensation must be either a sensation of musical tone or a sensation of noise. In the former case its composite character has been already shown. In the latter case, in the sensation of noise, rap, or puff, the truly primitive elements are sub-conscious psychical states answering to successive waves of unequal lengths. Any one of these waves by itself will not produce a genuine state of consciousness; it is only by compounding the sub-conscious psychical affections which they severally produce, that we obtain the so-called elementary sensation of noise or rap.

In every way, therefore, the conclusion is forced upon us that every one of our apparently simple auditory sensations is made up of a vast multitude of psychical affections, of which the really simple ones would never rise into consciousness save by being joined with others. Our simplest cognizable sensation of sound is

in reality a compound of the fourth or fifth, or even of some higher, order.

In the case of visual sensations, the same conclusion is reached by a precisely similar argument, sensations of colour differing from those of sound only as answering to wave lengths immeasurably shorter and more rapid in succession. It is unnecessary to insist upon the manifold analogies between sound and light, which are each day brought more vividly before the attention of the physical inquirer, as, for example, in the wonderful but plausible hypothesis lately propounded, that all the lines in the spectrum are simply the harmonic over-tones of a fundamental colour, which, being a couple of octaves below red, is itself invisible. Restricting our statement to ascertained points of resemblance, it may be said that the argument from the phenomena of musical pitch applies step by step to the phenomena of colour as we rise in the scale from red to violet; the only difference being that, as the slowest vibrations which the eye receives occur at the rate of about 458,000,000,000,000 in a second, we cannot experimentally distinguish, as in the case of the lowest sounds, the seemingly elementary sensation which answers to each couple of vibrations. Nevertheless, from experiments with the electric spark it has been shown that a sensation of

light which endures for one second is composed of at least a million successive sensations, each one of which, if separately excited, would rise into consciousness and be recognized as a flash of light. Now, as this flash of electric light is cognized as white, it follows that the cognizable sensation which lasts for one millionth of a second is really made up of at least three sub-conscious psychical states, which, if they were severally to rise into consciousness, would be severally cognized as red, green, and violet flashes, — these being the primitive elements of which the consciousness of white light is composed.[1] This fact alone shows that the method by which a sensation is formed out of sub-conscious psychical changes is essentially the same in the eye and in the ear.

No such elaborate investigations have been made with reference to the other peripheral sensations. Yet in the cases of smell and taste, the argument is not essentially different from what it is in the cases of hearing and vision. The physical antecedent, either of smell or taste, is a chemical reaction between particles of the odorous or sapid substance, and the ends of the olfactory or gustatory nerve fibrils. Now, a chemical reaction implies an enormous number

[1] [This assertion is based upon hypotheses as to the nature of colour vision which are no longer generally held by recent experimental psychologists.]

of undulatory movements by which myriads of molecules are seeking to reach a position of equilibrium. Accordingly, the end of the nerve fibrils in the olfactory chamber or in the tongue must be rapidly smitten by little molecular waves, just as the auditory filaments are smitten by atmospheric waves; and thus there is indicated a course of argument similar to that employed in the case of sound. It may be fairly argued that if each wave does not produce some sub-conscious psychical effect, the sum of the waves will not produce a state of consciousness known as smell or taste; so that here too the seemingly primitive sensation is really derivative and compound.

M. Taine's argument with reference to the tactile sensations is singularly beautiful, but no room is left for more than the briefest allusion to a few of its salient points. All tactile sensations are either dermal or muscular; that is, they are due either to disturbances of nerve fibrils embedded in the skin, or to disturbances of nerve fibrils embedded in the extremities of the muscles lying under the skin. In the first case, the sensation is either of contact or of temperature; in the second case, there is a sensation of resistance or pressure; and in both cases, when the sensation proper to the nerve is prolonged or intensified beyond a certain degree, it is at first accompanied and finally supplanted by a

sensation of pain. Now, Weber's experiments have shown that these differences in sensation are not due to the excitation of distinct nerves, but to the differently combined excitation of the filaments of the same nerves. The difference between the sensation of contact and the sensation of temperature depends upon the order in which the filaments of a particular nerve are set in vibration. And thus, as Fick observes, we may understand why it is difficult to distinguish between a prick from a needle and a minute burn from a spark of fire; for the nearer we approach to a truly elementary sensation, the more evanescent becomes the distinction between the compound sensation of temperature and that of mechanical contact. On the contrary, when a larger area of skin is suddenly rubbed or burned, so that enough nerves are brought into play to compound the elements of the sensations, then there is no difficulty in distinguishing the feeling of temperature from that of mechanical contact. From these and many other kindred facts, to which scanty justice is done by this cursory allusion, M. Taine very plausibly concludes that our ordinary tactile sensations are made up of little component psychical affections differing only in number, order, and duration; while, according as these elementary psychical states are differently compounded, they form conscious sensations which, as pre-

sented to consciousness, seem to be severally simple and distinct in kind.[1]

Throughout this remarkable analysis questions are suggested which can be completely answered only when physics and chemistry, as well as physiology and psychology, are much more advanced than at present. Yet there are three important principles which we may regard as established in the case of sound, and as clearly indicated in the case of the other sensations. The *first* is, that sensations which are apparently simple and elementary, and which cannot be analyzed by mere observation of consciousness, are nevertheless compounded of many successive and simultaneous sensations, which are themselves compounded of still lower psychical affections. The *second* is, that two sensations, which differ only in the mode in which their elements are compounded, may appear in consciousness as generically different and irreducible to each other. The *third* is, that two or more psychical affections which, taken separately, are as non-existent to consciousness, may, nevertheless, when taken together, coalesce into a sen-

[1] [The progress of Experimental Psychology has now rendered this paragraph antiquated. Both the empirical details regarding the skin sensations and the theory of their relations to the organs of sensation have entered upon a new stage since the discovery of the "temperature points" in 1884 (by Blix, Goldscheider, and Donaldson).]

sation which is present to consciousness. And when these three conclusions are presented in a single statement, they become equivalent to the conclusion above obtained from examining the beginnings of conscious intelligence in an infant; namely, that states of consciousness may be produced by the differential grouping or compounding of psychical states which are beneath consciousness.

This result is in entire harmony with what might be inferred *a priori* from the known characteristics of nerve action. Whether in the gray substance of ganglia, or in the white substance of nerve fibres, the physical action which accompanies psychical changes is an undulatory displacement of molecules resulting in myriads of little waves or pulses of movement. From this fact we might have suspected that, as a cognizable state of consciousness is attended by the transmission of a number of little waves from one nerve cell to another, so the ultimate psychical elements of each conscious state must correspond to the passage of these little waves taken one by one. And this inference, which by itself would be only a plausible guess, is raised to the rank of a scientific hypothesis by its harmony with the results of the analysis above sketched.

Thus we are led to infer, as the ultimate unit of which Mind is composed, a simple *psychical*

shock, answering to that simple *physical pulsation* which is the ultimate unit of nervous action. By the manifold and diverse compounding of myriads of such primitive psychical shocks, according to the slight structural differences of different nerves, are formed innumerable elementary sensations, which appear to be generically different; just as aquafortis and laughing-gas, which seem generically different, yet differ really only in the proportions of nitrogen and oxygen which compose them. By a similar differential compounding of these elementary sensations, we get complex sensations of blueness and redness, warmth, pressure, sweetness, roughness, and of various kinds of *timbre* and degrees of pitch. Carrying still farther the same process of differentiation and integration, we rise step by step to perceptions of greater and greater complexity, to conscious classifications, and to reasoning in its various forms, from the crude inferences of the child, barbarian, or boor, to the subtle and indirect combinations of the artist and the scientific discoverer. Thus amid all their endless diversities we discern, though dimly, a fundamental *unity of composition* throughout all orders of psychical activity, from the highest to the lowest.[1]

[1] [For a later criticism of this Taine-Spencer theory of the composition of mind, which might well have modified Fiske's acceptance of the theory had he rewritten this chapter, see James, *Principles of Psychology*, vol. i. pp. 151 sqq.]

Near the close of his first edition of the "Origin of Species," Mr. Darwin predicted that the establishment of his theory would eventually place the science of psychology upon a new basis — that of the acquirement of each mental faculty by slow gradations.[1] We seem now to have fairly started upon the path which leads to this desired goal. For while, among the mental operations above analyzed, some are peculiar to the highest human intelligence, there are others which are shared by the highest and the lowest human intelligence. Others — as the simplest inferences, several complex perceptions, and all the most simple ones — are shared by all human intelligence with the intelligence of apes, dogs, horses, and indeed of the majority of mammals, many birds, and possibly some lower animals. Others, again — as the simplest perceptive acts implied in recognizing a sensation — must be shared with all those animals whose nervous system is sufficiently complex to allow of their having any consciousness whatever. While others, finally — as the simplest sub-conscious groupings of primitive psychical shocks — must be shared by humanity with all

[1] Mr. Darwin has since recognized that this new basis is already well laid by Mr. Spencer. See *Origin of Species*, 6th edition, p. 428. Indeed the *Principles of Psychology*, upon which the present chapter is almost entirely founded, was first published in 1855, four years before the *Origin of Species*.

those forms of animal existence which possess any nervous structure whatever. For instance, that reflex action which occurs when the foot of a sleeping person, casually moved into a cold part of the bed, is quickly withdrawn without arousing any state of consciousness, involves the activity of a fragment of the human nervous system which corresponds in general structure to the entire nervous system of a medusa or jelly-fish. In such lowly creatures, then, we must suppose that the psychical actions which go on are similar to our own sub-conscious psychical actions. And, clearly, if we could trace the slow increments by which the nervous system has grown in heterogeneity, definiteness, and coherence, during the countless ages which have witnessed the progress from the primeval marine vertebrate to the civilized modern man, we should also be able to trace the myriad stages of the composition of mind, from the reflex contractions of a rudimentary fin, up to the generalizations of an Aristotle or a Newton.

CHAPTER XVI

THE EVOLUTION OF MIND[1]

THAT the amount of intelligence manifested by any vertebrate animal depends to a certain extent upon the amount of nerve tissue integrated in its cephalic ganglia, and especially in the cerebrum, is a truth familiar to every one, though often crudely stated and incorrectly interpreted. In the lowest vertebrate, the amphioxus, there is no brain at all. In fishes, the cerebrum and cerebellum are much smaller than the optic lobes; the cerebrum being in many large fishes about the size of a pea, though in the shark it reaches the size of a plum. Continuing to grow by the addition of concentric layers at the surface, the cerebrum becomes somewhat larger in birds and in the lower mammals. It gradually covers up the optic lobes, and extends backwards as we pass to higher mammalian forms, until in the anthropoid apes and in man it covers the whole upper surface of the cerebellum. In these highest animals it begins also to extend forwards. In the chimpanzee and gorilla the anterior portion

[1] [See Introduction, § 21.]

of the cerebrum is larger than in inferior mammals; but in these animals, as in the lowest races of men, the frontal extension is but slight, and the forehead is both low and narrow. In civilized man, the anterior portion of the cerebrum is greatly extended both vertically and laterally. As already observed, the most prominent physiological feature of human progress has been the growth of the cerebrum. The cranial capacity of an average European exceeds that of the Australians and Bushmen by nearly forty cubic inches; and the expansion is chiefly in the upper and anterior portions.

But this parallelism between increased intelligence and increased size of the cerebrum is complicated by a further parallelism between the amount of intelligence and the irregular creasing and furrowing of the cerebral surface. In the higher mammals both the cerebrum and the cerebellum are convoluted. But the convolutions do not correspond with any "bumps," real or imaginary, on the external surface of the skull; they are not symmetrical on opposite sides, like the fancied "organs" of the phrenologists; nor indeed, so far as the general brain surface is concerned, do they constitute elevations and depressions at all. The surface of the brain does not resemble a group of hills and valleys, but rather a perfectly smooth table-land cut here and there by very steep and narrow

chasms. A perfectly smooth lump of butter, irregularly furrowed by a sharp knife held perpendicularly, would present a surface like that of the human brain. Now the amount of intelligence depends in some way on the number and irregularity of these furrows. In the lowest monodelphian mammals, as the rodents and the lowest monkeys, there are no furrows, or only a few very shallow ones. In the carnivora and ungulata there are numerous furrows, some of them tolerably deep, but all of them symmetrically arranged. As we proceed to the higher apes, we find the furrows increasing in number and depth, though not yet losing their symmetry of arrangement. Idiots, young children, and adult savages have these creases few and regular; and in the lower races their arrangement is similar in different individuals. But in civilized man the creases are very numerous, deep and irregular; and they are not alike in any two individuals.[1]

[1] Phrenologists have done good service by familiarizing the unlearned public with the fact that the quantity of mental capacity is related to the quantity of brain. But the character of this relationship is seriously misinterpreted both by phrenologists and by the rest of the unlearned public. It is impossible to say that a man with an unusually large head must be a man of unusual mental capacity, because the quantity of mental capacity depends on many other factors besides quantity of brain. It not only depends upon the sinuous creasing of the brain-surface here described, which can in no wise be detected by an examination

The convolutions into which the human brain is divided by these furrows consist for the most part of "eight distinct and concentric layers, formed chiefly of closely packed fibres, and of crowds of cells of very different shapes, the layers differing in the relative proportion of cells and fibres, and in the manner of their arrangement."[1] Each cell sends forth processes with which the tissue of certain fibres becomes continuous. The office of the fibres is to es-

of the outside of the head, but it also depends largely, as Mr. Lewes well reminds us, upon the very important element of vascular irrigation. "Many individual variations in mental character depend on the variations in the calibre of the cerebral and carotid trunks — and many variations in the intellectual, emotive, and active tendencies depend on the *relative* importance of the cerebral and carotid trunks. The *energy* of the brain depends mainly on the *calibre* of its arteries; the special *directions* of that energy depend on the *territorial distribution*." *Problems of Life and Mind*, vol. i. p. 151. Again, the quantity of available mental energy which can be evolved in a given period of time depends, to a very great extent, upon the efficiency with which the blood is supplied with oxygen and freed from carbonic acid; so that mental capacity not only depends upon capacity of brain, but also upon capacity of lungs and liver. In short, a thorough examination shows that while Mind is most directly correlated with Brain, it is indirectly but closely correlated with the entire organism. So that the attempt to estimate individual differences in mental capacity by referring to brain-size alone is an utter absurdity.

[1] Maudsley, *Physiology and Pathology of Mind*, p. 55.

tablish communication between the cells.[1] Between millions of these cells there run millions of fibres, establishing communications in all directions. And the elaborate researches of Schroeder van der Kolk have gone far to prove that the shapes of the cells and the intricacy of their communications vary with the amount of intelligence. In various forms of mental disease, both cells and fibres undergo pathological changes, such as atrophy, hardening, softening, or some other form of degeneration. That is to say, not only are the activities of the cells impeded, but the channels of communication are variously obliterated or blocked up.

Between these fibres and cells there are differences of molecular structure implying differences in molecular activity. While the matter composing a cell is built up in enormously complex aggregates of molecules, wholly unshielded from external disturbance, the nerve matter of a fibre is protected throughout its entire length by a membranous sheath. And while it is probable that the action going on in a cell consists in the continual fall of unstably arranged molecules into a state of more stable equilibrium, from which a fresh rush of blood is continually raising them to their former unstable state; it is probable that the action going on

[1] [The form of statement here would be somewhat modified in the light of the modern "neuron theory."]

in a fibre consists in the successive isomeric transformations and retransformations of the systems of molecules which make up the fibre. These conclusions are quite probable, though not proven. But it is entirely proved that a cell is a place where nervous energy is liberated, while a fibre is a path along which nervous energy is transmitted.

Bearing all this in mind, it appears that the cerebrum and cerebellum are places where countless centres are constantly liberating nervous energy, and where this liberated energy is continually flowing along definite channels and from one centre to another. But to make the statement complete, we should add that much of the liberated energy is drafted off along centrifugal fibres into the corpora striata, whence it flows into the medulla and spinal centres, and is thus diffused over the body. Omitting the further consideration of these circumstances, let us inquire into the meaning of this unceasing interchange of molecular motion between the innumerable cells crowded together in the cerebrum and cerebellum. In other words, what are the functions of these supreme ganglia?

That their functions are not in any degree the direct coördination of sensations and movements would appear from the fact that these direct coördinations are already made in the spinal cord and in the medulla. All the mus-

cular adjustments made in the trunk and limbs are effected either directly by the spinal centres, or indirectly by the sympathetic ganglia in co-operation with the spinal centres. The medulla coördinates all these muscular adjustments with the muscular adjustments of the face, and with the impressions received from the specialized organs of sense. It is therefore highly improbable that the supreme ganglia can be in any way directly concerned with these coördinations. And the improbability is increased by the fact that the cerebrum and cerebellum are as destitute of sensation as the free ends of the finger-nails. Scratch one of the spinal centres, and the result is tetanus. Scratch the medulla, and the whole body is thrown into terrible convulsions. But the cerebrum and cerebellum may be scratched and sliced without pain or convulsion. They take heed only of those impressions which are communicated to them indirectly. Countless multitudes of nerve fibres coming up from the medulla are gathered together in the corpora striata; whence other fibres, continuing from them, radiate to the innumerable cells of which the supreme ganglia are composed.

We must conclude, therefore, that the functions of the cerebrum and cerebellum are comprised in the further compounding of the sensory impressions already compounded in the medulla. And as such compounding involves

the reproduction of impressions received in lower centres, and also involves the coördination of past with present impressions, we may say that the supreme ganglia are the seats of the higher psychical life, — of memory, reason, emotion, and volition. Dr. Maudsley has thus appropriately termed them the *ideational* centres. But between the functions of the two, thus closely related, there is nevertheless a difference. Although the precise determination of the way in which ideational functions are shared between the two centres has long remained a puzzling problem, there is good reason for believing that Mr. Spencer has solved the difficulty by assigning to the cerebellum the office of doubly compound coördination in space, and to the cerebrum the office of doubly compound coördination in time. The facts of comparative anatomy, and of comparative psychology, so far as known, are in harmony with this opinion. We saw in the chapter on Life and Mind that the extension of the correspondence in time at first goes on parallel with the extension of the correspondence in space — the increased area over which the organism can act being the measure of its increased capacity for adapting its actions to longer and longer sequences in the environment. But we saw also that in the human race the extension of the correspondence in time has gone on far more rapidly than the

extension in space — the most striking characteristic of intellectual progress being the ability of civilized man to adapt his inferences and actions to remote contingencies. Side by side with these facts, comparative anatomy shows us that the cerebrum and cerebellum at first keep pace with each other in growth; but as we reach those higher mammals which exhibit some degree of foresight, we find the cerebrum outgrowing the cerebellum and overlapping it, — while in man the growth of the cerebrum has been so great as to render comparatively insignificant all other changes in the nervous system. With the enormous cerebrum of civilized man we may further contrast the preponderant cerebellum in those carnivorous birds whose psychical life consists chiefly in the coördination of those extremely complex and remote space relations involved in the swooping upon prey from great distances. The human cerebellum is absolutely larger than that of such birds; but its smallness relatively to the cerebrum is a fact parallel with the simplicity of the space relations which man coördinates, as compared with the time relations. Among the latter are comprised all our ideas of cause, motion, progress, — in a word, all manifestations of force which involve the relation of sequence. But these ideas make up by far the largest and most heterogeneous portion of our psychical life.

I am inclined to regard these considerations as very powerful ones, — and there are several others which lead to the same conclusion. To present the case properly would require a whole chapter; but it is not essential for our present purpose that the question should be decided. Whether Mr. Spencer's view of the respective functions of the cerebrum and cerebellum be correct or not, it equally remains true that the class of functions shared by the two are ideational functions. They compound in double, triple, quadruple, or in far higher multiples, the sensory elements already simply compounded by the medulla. And it is in this compound grouping of impressions, past and present, according to their various degrees of likeness and unlikeness, that thought and emotion, the highest phases of psychical life, consist.[1]

A moment ago we asked, what is the meaning of the ceaseless interchange of molecular motion which goes on among the innumerable cells of the brain? We now see what is the meaning of it, for there can be but one meaning. The continual redistribution of nervous energy among the cells is the objective side of the process of which the subjective side is the

[1] [The Spencerian theory, especially as to the functions of the cerebellum, would hardly have been defended by Fiske had he rewritten this chapter in the light of later research. A new era has since dawned in the physiology of the brain.]

recompounding of impressions. If we may for a moment unduly simplify the matter, it may be said that for every renewed grouping of impressions, for every revived association of ideas, there is a nervous discharge between two or more cells, along formerly used sets of transit fibres; and for every fresh grouping of impressions, for every new connection of ideas, there is a discharge along new transit lines. In reality the matter cannot be so simple as this, since, as we shall presently see, the maintenance of consciousness implies a state of tension between many simultaneous discharges. But however great the complexity, the principle remains the same.

If it be objected to this view that it obliges us to assume a vast amount of differentiation and integration in the brain, during the lifetime of single individuals, it may be replied that the assumption is fully sustained, both by sound deduction and observation. Not only does the brain increase in size and heterogeneity during the first twenty-five years of life, but ordinarily it increases in heterogeneity, and often in size, for many years later; and in some cases it increases in heterogeneity until the end of life. The brain of a young child is in homogeneity like the brain of an ape; the furrows are shallow, symmetrical, and few in number. With advancing years they increase in number, depth,

and irregularity; and the increase is most marked in those persons who do the most brain work. In the brains of five very eminent men examined by Wagner, the heterogeneity of surface is described as quite astonishing. Such facts prove that the operations of thought work strongly marked structural changes in individual brains, in the course of a few years. And as these strongly marked changes are but the summing up of countless little changes in the arrangements of cells and fibres, the inference is inevitable that such little changes must be going on all the time. This is the testimony of observation, and deduction might have taught us to expect as much; since the molecules of nerve tissue are chemically by far the most unstable molecules known to science, ever ready to undergo metamorphosis and arrange themselves in new groups. Waste and repair go on more rapidly in the brain than in any other part of the body; the cerebrum, weighing between three and four pounds, receives at each pulsation one fifth of all the blood sent from the heart, and if the supply is stopped for an instant, consciousness ceases. Where nutritive change is so excessively rapid, such structural changes as are involved in the continual setting-up of new transit lines must be readily effected. And quite in harmony with this course of inference is the fact that when cerebral nutrition is nota-

bly retarded, as by the anæmia and feeble circulation of disease or old age, new associations of ideas become difficult or even impossible.

To sum up this whole preliminary argument: the cerebrum and cerebellum are organs whose function is ideation or the generation of ideal feelings and thoughts. They are organs made up of a tissue in which chemical changes occur with unparalleled rapidity. We cannot see these changes go on, but we can equally well infer their general character when we have examined the chemical properties and molecular structure of the tissue in which they occur. Microscopic and chemical examination of this tissue shows that these chemical changes must consist in a perpetual transfer of energy from one cell to another along transit lines composed of nerve threads. Bear in mind that the cell does not average more than one ten-thousandth of an inch in diameter, and that the quantity of matter contained in a transit line is almost infinitely small. Now since the cerebrum and cerebellum are, subjectively speaking, places where ideation is continually going on; and since they are, objectively speaking, places where nerve cells are continually sending undulations back and forth along transit lines; the inference seems forced upon us, that the transfer of an undulation from one cell to another is the objective accompaniment of each subjective unit

of feeling of which thoughts and emotions are made up. And if this be so, it becomes a mere truism to say that the formation of a new association involves the establishment of a new transit line, or set of transit lines, while the revival of an old association involves merely the recurrence of motion along old transit lines. That this is merely a hypothesis, I readily grant. Nevertheless it is a verifiable hypothesis; it is in harmony with all that we know of nerve action; and it may be held provisionally until some better one is propounded. When we proceed to see how many phenomena it explains, we shall be, I think, quite ready to admit that, if it does not contain the whole truth, it must at least contain a foreshadowing of the truth.

For we have now to note that, by a deduction from an established law of molecular motion, this hypothetical law of nervous action can be shown to explain that law of association which subjective analysis proclaims as the fundamental law of intelligence. In the chapter on Life and Mind, we saw that the chief business of psychology is to answer the question how there comes to be established in the mind a relation between two subjective states x and y, answering to a relation between two phenomena A and B in the environment. How is it that there is a subjective relation between the idea of sweetness and the group of ideas comprised in

the visual perception of a peach, answering in some way to the objective relation between the coexistent properties of the peach, so that the presentation of the one to the cephalic ganglia is inevitably accompanied by the representation of the other? This question lies at the bottom of psychology, and we have now to see how it is to be answered. The answer will lead us through a portion of the domain of molecular physics, and will incidentally give us a hint concerning the genesis of nervous systems.

In the chapter on Matter, Motion, and Force, it was shown that all motion takes place along the line of least resistance, whether the motion be the movement of a mass of matter through a resisting medium, or the passage of a series of undulations through the molecules of an aggregate. Let us reconsider this truth in one of its concrete applications.

When a wave of molecular motion traverses a mass of matter for the first time, the line of least resistance will of course be determined by the intimate structure of the mass. But now mark what happens. Immediately after the passage of the wave, the intimate structure of the mass, in the vicinity of the line along which the wave has travelled, is different from what it was a moment ago. The passage of the wave has pushed a linear series of molecules out of position, and a short time must elapse before these

molecules can return to their positions. Therefore if the first wave is instantly followed by a second, starting from the same point, the line already traversed will be the line of least resistance, even more decidedly than before. The second wave will encounter less resistance than the first wave, because it will find its work of altering the positions of the molecules already partly done for it. Thus, according to the molecular mobility of the matter in question, the transit of succeeding waves, along the line once established, will rapidly become less and less hindered. And the process must go on either until the inertia of the molecules along the transit line opposes a minimum of resistance to the passage of the wave, or even until the energy given out by the molecules in changing position adds to the momentum of the wave. In either case there is established a permanent line of least resistance, along which all subsequent waves that start from the same point must travel. The most familiar illustration of this process is afforded by the facts of magnetization, which show "that the establishment of undulations along certain lines determines their continuance along those lines."[1] The case of

[1] An illustration of this principle is perhaps to be found in the mellowing of old violins. According to Professor Tyndall, "the very act of playing has a beneficial influence; apparently constraining the molecules of the wood, which in the

liquid matter flowing through solid matter — as when currents of rain water, percolating through loose soil, gradually break away obstructing particles and excavate small channels which ultimately widen and deepen into river-beds — is a case in which similar dynamic principles are involved. In all these cases, "if we confine our attention to that part of the motion which escaping transformation continues its course, then it is a corollary from the persistence of force that as much of this remaining motion as is taken up in changing the positions of the units must leave these by so much less able to obstruct subsequent motion in the same direction." [1]

Now in the case of organic bodies, the enormously complex molecular changes involved in

first instance were refractory, to conform at last to the requirements of the vibrating strings." *On Sound*, p. 90. As Dr. Maudsley would say, "musical residua" remain in the molecular structure of the wood.

[1] Spencer, *First Principles*, p. 248. [Part II. chapter ix. § 81, near the close of the section.] Thus, though Mr. Mill is justified in saying (*Inaugural Discourse*, p. 62) that "physiology is the first science in which we [distinctly] recognize the influence of habit — the tendency of something to happen again merely because it has happened before," — yet, as we here see, the phenomena of habit are foreshadowed in the inorganic world. An admirable instance of that continuity among phenomena which is everywhere implied by the theory of evolution.

nutrition are such as to aid in the setting-up of the most perfect transit lines. In an inorganic mass the molecules have comparatively little mobility, and they do not leave their connections from moment to moment, to be instantly replaced by new molecules. But the complex clusters of molecules which make up living tissue possess immense mobility, and they are continually falling to pieces and getting built up again. Consequently the repeated passage of waves either of fluid matter or of molecular motion along a definite line of least resistance, not only changes the positions of the molecular clusters, but also modifies the nutritive changes by which the temporary equilibrium of the clusters is restored. Instead of a set of relatively homogeneous molecules, which are simply pushed aside and then tend to oscillate back again, the advancing wave encounters a heterogeneous edifice of molecules, which tumbles to pieces and is instantly rebuilt. But in the rebuilding the force exerted by the advancing wave has to be expended; and the result is that in the rebuilt cluster there is a surplus tension exerted in the very direction in which the waves are travelling. The transit lines thus become far more permeable than any which can be established in inorganic bodies. The energy given out by the decomposing cluster of molecules adds to the momentum of the wave; so that

the line of least resistance becomes to a certain extent a line of traction. A good illustration is afforded by the gradual evolution of the circulatory system as we ascend in the animal scale. In the lowest animals which possess any nutritive fluid perceptibly distinct from the protoplasmic jelly of which their bodies are composed, this fluid percolates here and there at seeming random, its course being determined by local pressures, just as in the case of rain water trickling through the ground. Now as we ascend to higher animals, we find that the nutritive fluid has wrought for itself certain channels, to which it confines itself, and which gradually become more and more definite in direction, and more and more clearly demarcated from the adjacent portions of tissue. Until, when we reach animals of a high type of structure, we find the blood coursing through permanent channels, the walls of which contract and expand in such a way as to assist the blood in its progress. A similar explanation is to be given of the genesis of the contractile fibres of muscle, as due to the continuance of molecular undulations along certain lines.

When we come to the nervous system, we find most completely realized all the conditions requisite for the rapid establishment of permanent transit lines. The clusters of molecules of which nerve tissue is composed are more heter-

ogeneously compounded than any other known systems of molecules; and the alternate pulling to pieces and putting together of these clusters, which we call nutrition, goes on here with unparalleled rapidity. Of all known substances, nerve is the most changeable, the most impressible, the most readily adaptable to changing combinations of incident forces: in short, the most easily differentiable and integrable. Hence we find that those long transit lines, known as afferent and efferent nerves, are not only so constituted that a wave of disturbance set up at one end is immensely increased before it reaches the other end, but are also protected by enveloping clusters of molecules in such a way that none of the transmitted motion is allowed to escape laterally. Ease of transit is here witnessed at its maximum.

Making use of these theorems of transcendental physics, and applying to the problem his vast and accurate knowledge of biological details, Mr. Spencer has propounded a theory of the genesis of nervous systems of all orders of complexity, which, whether entirely or only partially true, must be regarded as one of his most brilliant achievements. In the lately published "Physical Synthesis," which concludes the first volume of his "Principles of Psychology," Mr. Spencer shows that the irritability which characterizes the entire surface of the lowest ani-

mals, and which probably consists in the isomeric transformation of colloidal clusters of molecules distributed over the surface, must gradually become concentrated in certain definite transit lines, just as the circulation of a nutritive fluid becomes confined to certain channels: while the collision of waves which takes place wherever two or more of these transit fibres inosculate must result in such chemical changes, and in the gradual formation of such a structure, as characterize nerve centres. But the exposition, when carried into details, is altogether too abstruse to be profitably presented here, nor is it necessary for our present purpose. The explanation of the laws of association only requires that, starting with some kind of nervous system as already established, we should examine the character of the nutritive changes set up within it by environing agencies.

The foregoing argument shows us that the most prominent characteristic of such changes is the formation of transit lines between neighbouring cells; and we have seen that the more frequently a wave of molecular disturbance passes along any such transit line, the more easily will it pass, and the more difficult will it be to divert it into any other transit line. Hence in any complex aggregate of cells and fibres, like the human brain, we may expect to find a countless number of transit lines, of all

degrees of permeability. Those which have been oftenest traversed will be the most permeable, and those which are traversed only at rare intervals will be but slightly permeable; while the passage of a nervous discharge in a new direction will involve the differentiation of a new line of transit.

Now subjective psychology furnishes us with an exact parallel to this state of things. The profound analysis of conscious changes carried on by the English school of psychology since the time of Hobbes, and accepted by the Kantian school in all save a few very important instances — which we shall presently see to be similarly explicable — has ended in the conclusion that states of consciousness cohere with a strength dependent upon the frequency with which they have been repeated in experience. In other words, "the persistence of the connection between states of consciousness is proportionate to the persistence of the connection between the agencies to which they answer." This fundamental law of association is illustrated by such familiar truths as the following: "that phenomena wholly unrelated in our experience, we have no tendency to think of together; that where a certain phenomenon has occurred in many relations, we usually imagine it as recurring in the relation in which it has most frequently occurred; that when we have witnessed

many recurrences of a certain relation we come to have a strong belief in that relation ; that if a relation has been daily experienced throughout life with scarcely an exception, it becomes difficult for us to conceive it as otherwise — to break the connection between the states of consciousness representing it ; and that where a relation has been perpetually repeated in our experience with absolute uniformity, we are entirely disabled from conceiving the negation of it."[1]

The correspondence between the subjective and the objective sides of the phenomena is thus complete, and the increasing complication of cell and fibre in the brain, from infancy to old age, is seen to have a psychological meaning. If the acquisition of a new idea is attended by the passage of a wave of molecular motion along a new path, and if recollection is a state of consciousness attending the transmission of a later wave along the same path, we have an adequate physical interpretation of the fact that the repetition of an idea is favourable to the recollection of it. And we have also the physical interpretation of habit and prejudice. Molecular motions that have been repeatedly transmitted between particular groups of nerve cells end by establishing more or less intricate webs

[1] Spencer, *Principles of Psychology*, vol. i. p. 421. [Part II. chapter iii. § 189.]

of transit lines which cannot be obliterated. No effort can prevent their occasional recurrence along these lines, or establish a new plexus of transit lines, involving the derangement of the old ones. Late in life, when the ratio of repair to waste is greatly diminished, when the nutrition of the cerebral tissue is impaired, when the pulling to pieces and putting together of molecular clusters in which nutrition consists goes on slowly, then the formation of new sets of transit lines becomes especially difficult; and hence, as we say, the shaking off of old habits and prejudices, and the acquiring of new and strange ideas, is next to impossible. It is proverbially hard to teach an old dog new tricks. We may here also see why it is impossible to learn or to carry on complicated thinking when in a state of anæmia: the nutritive changes go on too slowly. Changes in memory further illustrate the theory. In youth, when the excess of repair over waste is at the maximum, but few discharges through any transit fibre are needful in order to work a permanent nutritive change, setting up a line of communication which shall last through life: hence learning is easy and rapid, and memory is powerful. In old age, when waste is slightly in excess of repair, and both are at the mimimum, a great many discharges are necessary for the achievement of any permanent nutritive change, — hence learning is

slow and difficult, and memory is feeble. And hence — what is most significant of all — the old man does not remember recent events, while he remembers very well what happened in his youth, when his rate of nutrition was rapid. These and countless similar facts show us that a state of consciousness and a nutritive change in the cephalic ganglia are correlated like the subjective and objective faces of the same thing. And thus are explained the many facts which in the seventh chapter were brought forward in illustration of the transformations of vital energy, — such as the facts that consciousness ceases the instant the carbonic acid in the blood has attained a certain ratio to the oxygen; that much thinking entails a great excretion of alkaline phosphates; and that prolonged mental exertion is followed by a bodily fatigue and a keen appetite not essentially different from the fatigue and hunger which follow muscular exercise.

Regarding it now as provisionally established that an association of ideas is dependent upon the formation of a transit line between two nerve cells, and that the more often the fibrous path is traversed the more indissoluble will be the association, let us proceed briefly to apply this doctrine to the explanation of sundry psychical phenomena. Now as we begin to examine the simplest psychical phenomena — those of reflex

action and instinct — we are met by the seeming difficulty that indissolubly connected psychical states occur where the corresponding objective relation has *never* been repeated within the experience of the individual. Instinctive adjustments of inner to outer relations are apparently made without any help from experience. Moths and butterflies take to wing immediately on emerging from the envelope of the chrysalis; "a fly-catcher, immediately after its exit from the egg, has been known to peck at and capture an insect;" and "a young pointer will point at a covey the first time he is taken afield." But in such cases as these, where the cohesion of psychical states has not been determined by the experience of the individual, it has nevertheless been determined by the experience of the race. That the repetition of ancestral experiences must end in the automatic cohesion of psychical states is both demonstrable *a priori* and illustrated by many facts. Birds living in islands uninhabited by men will not fly away when approached by travellers, having none of that instinctive fear which "continued experience of human enmity has wrought" in other birds. Yet in a few generations these birds will acquire the same instinctive fear. In many cases the offspring of a dog that has been taught to beg will beg instinctively; and various peculiarities of demeanour, carefully impressed by education upon sporting

dogs, are manifested without education by their descendants. Indeed it is familiar to breeders that the dispositions and instincts of domestic animals can be to a certain extent modified by training and selection, no less than their physical constitutions.[1]

The physical explanation of the automatic cohesion of psychical states implied in hereditary instinct is not difficult at this stage of our inquiry. When the experience of many past generations has uniformly contributed to establish a certain arrangement of transit lines in the chief ganglia of the animal, there must be a hereditary tendency for such transit lines to develop by the mere process of nutrition. And where the psychical life is very simple, and but little varied from generation to generation, a nervous system

[1] "How strongly these domestic instincts, habits, and dispositions are inherited, and how curiously they become mingled, is well shown when different breeds of dogs are crossed. Thus it is known that a cross with a bulldog has affected for many generations the courage and obstinacy of greyhounds; and a cross with a greyhound has given to a whole family of shepherd dogs a tendency to hunt hares. These domestic instincts, when thus tested by crossing, resemble natural instincts, which in a like manner become curiously blended together, and for a long period exhibit traces of the instincts of either parent: for example, Le Roy describes a dog whose great-grandfather was a wolf, and this dog showed a trace of its wild parentage only in one way, by not coming in a straight line to his master, when called." Darwin, *Origin of Species*, 6th edition, p. 210.

embodying certain organized aptitudes will be transmitted as surely as the muscular or vascular system is transmitted. Nervous discharges will run along preëstablished transit lines as inevitably as in human beings the nervous discharges which regulate the respiratory and alimentary movements run in permanent channels. The character of the process is best exemplified in *reflex action*, the simplest form of psychical life. In reflex action, which is unaccompanied by consciousness, a single inner relation is adjusted to a single outer relation. For the simpler kinds of reflex action nothing is needed but what is called a *nervous arc;* that is, an afferent nerve, a ganglion, and an efferent nerve. When a person sound asleep draws away a limb that is touched, the impression is simply carried along an afferent nerve to one of the spinal ganglia, and thence reflected along an efferent nerve to the muscle which moves the limb. The assistance of the brain is not needed. In many animals the limbs thus respond to stimuli after the head has been cut off or the brain sliced away. This kind of psychical life, which is but one degree removed from purely physical life, is all that is manifested by those lowly organized animals whose nervous systems consist of simple arcs. So thoroughly physical is this group of phenomena that it may seem almost inappropriate to call it psychical: nevertheless it forms

the transition from the one kind of life to the other. It is the lowly beginning from which higher forms of psychical activity arise.[1]

Now in reflex action, as it is exemplified alike in the rhythmical movements of our heart, lungs, stomach, and other viscera, and in the contraction of a polyp's tentacle when food comes against it, we see a series of nervous discharges which are automatically directed along certain definite transit lines. The lines of least resistance have become permanently organized in the animal structure, and they are transmitted, with the accompanying capacities of action, from generation to generation. Here we see "indissolubly connected psychical states existing where there are perpetually repeated experiences of the external relations to which they answer."

The phenomena of *instinct* are more distinctly psychical than those of reflex action. "While simple reflex action is common to the internal visceral processes and to the processes of external adjustment, instinct is not. There are no instincts displayed by the kidneys, the lungs, the liver: they occur only among the actions of that

[1] [While Fiske would probably still maintain his thesis at this point, the modern controversy as to the heredity of acquired characters has rendered these reasonings as to the origin of instinct more doubtful than they were to the evolutionists of Fiske's day. See James, *Principles of Psychology*, vol. ii. chapter xxviii.]

nervo-muscular apparatus which is the agent of psychical life." Instinct, moreover, implies the coördination of a large number of stimuli with the answering movements, and herein is its chief difference from reflex action, — a difference in degree only. The newly hatched fly-catcher, in seizing a fly, shows "an exact appreciation of distance, as well as a power of precisely regulating the muscular movements in accordance with it." The number of impressions and movements here coördinated is so considerable that it would take several pages to describe them thoroughly. Here certain systems of transit lines, involved in the establishment of a correspondence in space, are wrought by nutrition in the animal's nervous system so completely that when the outer relation occurs the discharge instantly takes place along the preëstablished channels, and the adjustment is made. There is an intricate compounding of reflex actions, involving the assistance of the brain; for if the cerebellum be sliced, the fly-catching can no longer be performed. Intricate, however, as the combination is, it is a special and unvarying one which has been continually repeated during the whole lifetime of countless ancestral fly-catchers, so that there is nothing strange in the fact that it is completely organized at birth. The principle is the same as in the simpler phenomena of reflex action. Here, as before, extending the

experience theory to the entire race, we see "indissolubly connected psychical states existing where there are perpetually repeated experiences of the external relations to which they answer."

Though the higher kinds of instinct, in which the supreme ganglia coöperate, are probably accompanied by a vague consciousness, yet in the main the processes which we have just described must be regarded as automatic. Let us now notice what must occur when the correspondence between inner and outer relations has become quite complex and special. As Mr. Spencer has pointed out, "phenomena become less frequent in proportion as they become more complex; and hence the experiences of them can never be so numerous as are the experiences of simple phenomena. The relation between a passing obscuration and a living body recurs oftener than the relation between a certain degree of obscuration and danger, or than the relation between a certain other degree of obscuration and food. Again, each of these relations is more general than the relation between a particular size and form of visual impression and an object of a particular class. And again, this relation is more general than that between a particular size, form, and colour of visual impression, and a certain species of that class." [1] From this

[1] Spencer, *Principles of Psychology*, vol. i. p. 441. [Part IV. chapter v. § 197.]

it follows that a lowly organized animal, in which there is established a correspondence only with the most general environing relations, and which therefore has experience only of such most general relations, has at the same time a uniform experience which maintains a complete cohesion among its simple psychical states. On the other hand, a highly organized animal, in which there are established correspondences with many complex and special relations, will have a varied experience, and at the same time a varying cohesion among its complex psychical states. While the most general relations which it experiences will also be the most frequent, and while sundry special relations (as in the seizing of its prey by the fly-catcher) will be extremely frequent, there are many other special relations of which the experience will be much less frequent. And accordingly, along with the perfectly coherent psychical states generated by the former, there will be a congeries of less coherent psychical states generated by the latter. Or, to restate the case in physiological language: While in the lower organism there will be a number of transit lines permanently established, and scarcely any tendency toward the formation of new ones; on the other hand, in the higher organism, there will be a number of permanent transit lines and a number of such lines in process of formation, along with a continual tendency toward the es-

tablishment of new ones. The consequences of this are obvious. In becoming more and more complex, the correspondences become less and less instantaneous and decided. "They gradually lose their distinctly automatic character, and that which we call Instinct merges into something higher."

For as long as the psychical life consists solely in the passage of nervous undulations along permanent preëstablished channels, there is no consciousness. Consciousness, as already shown, implies continual discrimination, or the continual recognition of likeness and differences — and this process implies a rapid succession of changes in the supreme ganglia. Now this rapid succession of changes occurs when a vast number of relations are brought together in a single ganglion, or group of ganglia, as in the cerebrum, in order to be compared with each other. Besides this, consciousness implies a certain lapse of time during which impressions persist; and there is no such persistence in reflex action, or in the lower forms of instinct, where the molecular disturbance constituting a nervous impression is instantly drafted off along the preëstablished channels. Such persistence occurs only when a number of impressions are brought together in a single ganglion, where an appreciable time must elapse before they are carried off each along its own set of transit lines.

For example, when you tickle or pinch the arm of a person asleep, the arm is at first withdrawn by simple reflex action: the ordinary channel, through the afferent nerve to the spinal centre and back again through the efferent nerve to the limb, suffices to carry off all the molecular disturbance, — and there is no consciousness of the irritation or of the resulting contraction. But if the pinching be frequently repeated, so that the disturbance is generated faster than it can be thus drafted off, the surplus is sent up through a centripetal fibre from the spinal ganglion to the brain; and some dreaming ensues, or perhaps a fretful sound is emitted. If the impression be kept up long enough, there is full consciousness of it, and the person awakes. Now the rise of consciousness implied in the dreaming and waking is due to the persistence in the cerebrum of a molecular disturbance which is not at once drafted off through the proper centrifugal fibres.

Obviously, therefore, when the number of impressions sent in to the brain from moment to moment exceeds the number of thoroughly permeable channels which have been formed there, so that there is a brief period of tension during which occur the nutritive changes implied in the transmission of the disturbance through the appropriate channels, then there arise the phenomena of conscious intelligence. For mark

what must happen. In the *first* place, the persistence of the impressions enables them to be consciously felt, either pleasurably or painfully; so that there is the germ of Emotion. *Secondly*, the disturbance tends to propagate itself along various permeable transit lines, so that there is a revived association of ideas, or what we call Memory. *Thirdly*, there is an integration of the present impressions with such past ones as they resemble, and a differentiation of them from such past ones as they do not resemble; and this comparison of present with past impressions, dependent on memory, implies classification, and is the germ of what we call Perception and Reasoning. *Fourthly*, there is, in the case of many kinds of impressions, a period of tension during which it becomes determined along what set of centrifugal fibres the surplus disturbance shall be drafted off, and here we have the primitive form of Volition. Thus the various phases of conscious psychical life — which we call emotion, memory, reason, and volition — arise as soon as there begins to elapse an appreciable time between the accumulation of molecular disturbance in a group of cephalic nerve cells, and its discharge along the proper transit fibres. And this state of things, which is not possible in simple nervous systems which only respond instinctively or by reflex action to a few general relations in the environment,

becomes possible in those compound nervous systems which respond to a great number of infrequent and special relations. For the establishment of inner relations, answering to these infrequent and special outer relations, involves a lapse of time during which numerous diverse impressions are getting distributed through various transit lines hitherto little used. When, as in the fully developed human cerebrum, a vast number of infrequent and special relations are continually set up, there is a maximum of nutritive change, there is a maximum of time during which impressions simultaneously coming in may be compared and classified, and there is a maximum of consciousness.

This explanation of the way in which the various phases of conscious psychical life arise is fully confirmed by the way in which they disappear when actions at first consciously performed become instinctive. The confirmation is so complete as to afford a very strong proof of the truth of the hypothesis. Many of the actions performed by civilized man are designated by psychologists as "secondarily automatic." That is, they are at first performed with the assistance of reason, volition, and conscious memory, and they are attended by feelings of pleasure or pain. But after a while they are performed without the aid of reason, volition, or conscious memory, and they are not attended

by pleasurable or painful feelings. In becoming instinctive, they lapse partially or entirely from consciousness. The child in learning to walk and talk must will each movement and rationally coördinate it with other movements in order to attain the desired end. But the man, in walking and talking, is unconscious of the separate movements and volition serves only to set them going. In learning to read, the child must consciously remember each letter, combine it with others into a word, and associate the word with the thing signified; and this last process is repeated in later years when we learn foreign languages. But in reading our own language, or a foreign one which has been thoroughly learned, the association of words and things is automatic. In reading an English book, in which French quotations are inserted, one frequently passes from one language to the other and back again without noticing the change, if the attention be concentrated on the subject matter. In learning to play the piano, there is at first a vast amount of conscious association between the written notes, the keyboard, and the muscular adjustments of the fingers, wrists, and arms; but an accomplished pianist will play a familiar piece while his attention is directed to other matters. The case is similar with writing, and indeed with all habitual actions which require nervo-muscular coördination. In many

cases, moreover, the intervention of conscious attention only impairs the accuracy of adjustment. In billiard playing and rifle shooting, the aim is usually impaired if we stop to think about it; and on the piano it is almost impossible to play triple notes with one hand and double notes with the other if we attempt to measure out the time.

Purely intellectual acts also become to a certain extent automatic with practice, as was indeed implied in some of the foregoing illustrations. Not only the combination of words into a sentence, but the combination of sentences into a proposition, and the combination of propositions into a theory, is effected more and more rapidly, until the process hardly attracts the attention. In a complicated exposition like the present, numerous scientific theorems, at first laboriously comprehended one by one, are wrapped up together and thrown into some subordinate clause of a sentence, the total being so obvious as not to withdraw the attention from the main current of thought while writing. In such facts we have a partial explanation of many of the phenomena of what is called unconscious or "sub-conscious" thinking. And thus, too, are to be explained those sudden flashes of insight, scientific or poetical, which in early times were attributed to inspiration or dictation from without. Obviously without a good

deal of such automatic acting and thinking, we could achieve but little in art or science. We should never become good pianists if we had to keep paying attention to all the requisite muscular adjustments; and science would advance but slowly if at each step of an intricate inquiry in dynamics it were necessary to stop and reflect upon the elementary laws of matter and motion.

The physical interpretation of these secondary automatic processes is not difficult, according to the hypothesis here expounded. During the process of learning, there is an extensive formation of new transit lines, and consequently an appreciable interval between the accumulation of molecular disturbance in the cerebral cells and its discharge. Impressions persist long enough to be compared together, and accordingly there is reason and there is volition. There is a maximum of consciousness, because there is a maximum duration of the nutritive changes, and hence weariness soon follows — cerebral nutrition entailing greater waste than occurs in any other part of the system. But with constant repetition the resistance to the passage of undulations along the new transit lines disappears entirely. Nutrition has so modified them that, as above explained, they become lines of traction instead of lines of resistance. As we say, nothing can prevent the

one group of ideas or movements from following the other. The discharges are made instantly, and along with a minimum duration of nutritive change there is a minimum of consciousness. The combinations become permanently organized in the brain structure, and in becoming permanently organized they become instinctive or automatic.

We may now also begin to understand why it is that in man the organization of instincts, primary and secondary, is continued through the early years of life, while in the other animals the majority of the instincts are already organized at birth. The distinction is not an absolute one, as many of the higher vertebrates, both birds and mammals, and in a marked degree the anthropoid apes, cannot take care of themselves immediately after birth, though they soon become able to do so. The lower we descend the animal scale, the more completely organized is the psychical life of the newly born organism. The reason is obviously to be found in the greater speciality and complexity, and the consequent relative infrequency, of the coordinations made by the highest animals, and especially by man. When, for example, we put forth the hand to grasp an object, the muscular adjustments are as instinctive as those of the fly-catcher pouncing on an insect; "volition being concerned merely in setting the process

going." But with us, the impressions which we receive and the motions which we make are endlessly varied, and the complex combinations of them occur *severally* with less frequency than is the case with the simpler combinations formed by lower animals. They are accordingly not coördinated before birth, though they are easily coördinated during childhood.[1]

A great number of psychical phenomena are thus satisfactorily explained by the hypothesis. But one further service, and a most signal one, is rendered by it; and this we must briefly indicate, in accordance with previous promises, before leaving the subject. The view of cerebral action here adopted settles the long-vexed question between the Lockian and Kantian schools as to the sources of knowledge; and the verdict, while partly favourable to each of these schools, is not wholly favourable to either. Let us reconsider the portion of our hypothesis which bears upon this question.

It follows from the general principles involved in the foregoing exposition, that the peculiar intellectual activity of any parent, by

[1] In the concluding chapter of this Part, I shall endeavour to show that this origination and prolongation of the period of infancy, which is the effect of increasing intelligence, is in turn the proximate cause of the genesis of social relations and of ethical feelings, and thus, indirectly, of the entire intellectual and moral supremacy of man.

modifying the nutrition of his cerebral tissue, must impress itself upon the unstimulated and half-developed brain of his infant offspring. Eliminating the effects wrought in it by countless environing circumstances, we may say that the infant brain just as surely tends to develop transit lines similar to those in the parental brain as the infant face tends to develop muscular peculiarities of expression like those characteristic of the parental face. And while the tendency is so slight as to count for little or nothing in the case of the more complex and infrequent associations of ideas, it must be a resistless tendency in the case of those nerve connections which answer to associations involved in every act of experience, — as, for example, those concerned in building up our conceptions of space, time, force, and causation. A concise restatement of the case will now lead us at once to our conclusion. While ancestral experience impresses upon the brain a nutritive tendency toward the formation of certain special nerve connections, individual experience tends now to assist and now to check the inherited tendency. And so the number and direction of transit lines in any brain is due to the coöperation of innumerable ancestral and individual experiences. Locke was therefore wrong in calling the infant's mind a blank sheet upon which experience is to write knowledge.

The mind of the infant cannot be compared to a blank sheet, but rather to a sheet already written over here and there with invisible ink, which tends to show itself as the chemistry of experience supplies the requisite conditions. Or, dropping metaphor, the infant's mind is correlated with the functions of a complex mass of nerve tissue which already has certain definite nutritive tendencies. On the other hand, the school of Leibnitz and Kant was wrong in assuming a kind of intuitional knowledge not ultimately due to experience. For the ideas formerly called innate or intuitional are the results of nutritive tendencies in the cerebral tissue, which have been strengthened by the uniform experience of countless generations, until they have become as resistless as the tendency of the dorsal line of the embryo to develop into a vertebral column. The strength of Locke's position lay in the assertion that all knowledge is ultimately derived from experience, — that is, from the intercourse between the organism and the environment. The strength of Kant's position lay in the recognition of the fact that the brain has definite tendencies, even at birth. The Doctrine of Evolution harmonizes these two seemingly opposite views, by showing us that in learning we are merely acquiring latent capacities of reproducing ideas ; and that beneath these capacities lie more or less powerful nu-

tritive tendencies, which are transmissible from parent to child.

I believe that the last difficulties which may have hovered about the doctrine of the Test of Truth, expounded in the third chapter of our Prolegomena, are now swept away. It must be by this time quite clear that the inconceivability test and the experience test are merely the obverse faces of the same thing. An association of subject and predicate, which answers to an objective relation of which the experience has been absolutely uniform, must be absolutely indissoluble; and *vice versa.* The ultimate question at issue between Mr. Mill and Mr. Spencer thus becomes reduced to a question of terminology, save in one important particular, in which I have already shown that Mr. Mill is not only demonstrably wrong, but also inconsistent with himself. The foregoing exposition adds new weight to the argument by which it was formerly (Part I., chapter iii.) proved that when Mr. Mill asserts that the negation of such an axiom as the indestructibility of matter, which is now inconceivable, was in past times conceivable, he virtually asserts that there was a time when men could frame inner relations of which the corresponding outer relations had never been presented in experience. And thus he not only runs counter to the general theory of Life as Adjustment which is here adopted, but he

contravenes his own favourite doctrine of the experiential origin of all knowledge, which is in reality part and parcel of that general theory of life.

With these corollaries I must conclude this too brief account of the process of psychical evolution. In the present chapter and its two predecessors, while steadily refraining from the chimerical attempt to identify Mind with some form of Matter or Motion, it has nevertheless been shown that, owing to the mysterious but unquestionable correlation which exists between the phenomena of Mind and the phenomena of Matter and Motion, it is possible to describe the evolution of the former by the same formula which describes the evolution of the latter. By a continuous differential compounding of impressions, we pass, through infinitesimal stages, from the relatively homogeneous and simple set of correspondences known as reflex action, manifested alike by the highest and the lowest animals, to those exceedingly complex and heterogeneous sets of correspondences known as reason and volition, which are manifested only by the highest animals, and in their greatest complexity by man alone. Throughout this wonderful process we have seen how closely the evolution of psychical function is correlated with the evolution of nerve structure. But great as has been our gain during the foregoing exposi-

tion, our theory of psychical evolution is as yet by no means complete. Concerning the relations of Mind to Life, and concerning the Composition and Evolution of Mind in general, we have obtained many valuable results. But nothing has as yet been said concerning the especial mode of genesis of those highest manifestations of thought and feeling which distinguish civilized man. This problem must be duly treated before our account of psychical evolution can be regarded as complete even in outline. Upon questions of this sort, however, we are not yet prepared to enter. Those highest manifestations of thought and feeling which distinguish civilized man from inferior mammals, and in a less-marked degree from uncivilized man, are the products of countless ages of social evolution; and before we can hope to understand their mode of genesis, we must see what are the teachings of history and psychology concerning the character of social evolution in general.

Having shown how, starting from a relatively low degree of sociality, a relatively high degree is attained in conformity to the general theory of Life as Adjustment, we shall be better enabled to comprehend the genesis of that lowest degree of sociality, the attainment of which was the decisive step which first raised Man above the level of the Brutes. The four following chapters will therefore be concerned with Sociology;

and the first will be devoted to clearing away a complicated misunderstanding, by the help of which metaphysicians have long sought, and still seek, to deter us from applying scientific methods of interpretation to the phenomena of human history.

CHAPTER XVII

SOCIOLOGY AND FREE-WILL[1]

THAT the phenomena manifested by human beings, as grouped in societies, conform to fixed and ascertainable laws is a proposition which has thus far been taken for granted, inasmuch as it is logically inseparable from the other sets of propositions which go to make up our Cosmic Philosophy. Not only, moreover, have we thus tacitly assumed that social phenomena conform to law and may be made the subject of science, but in the fourth chapter of this Synthesis it was expressly stated that the fundamental law to which they conform is the Law of Evolution, which has now been proved to hold sway among inorganic and organic phenomena, as well as among those superorganic phenomena which we distinguish as psychical. Under ordinary circumstances we might fairly go on and justify our tacit assumption and our explicit assertion by showing, both deductively and inductively, that the evolution of society follows in general the same method as the evolution of organic life. In the follow-

[1] [See Introduction, § 22.]

ing chapter I shall proceed to do this. I shall show, first, that social evolution consists in the integration of human families or tribal communities into larger and larger groups, which become ever more heterogeneous and more interdependent; and secondly, that what we call civilization consists in the ever increasing definiteness and complexity of the correspondence between the community and the environment. Thirdly, I shall carry on the inquiry to a point somewhat in advance of Mr. Spencer's exposition as it now stands, and show how these truths must be supplemented in order to give us a law of social evolution which shall cover social phenomena simply, excluding the more general phenomena of organic life.

But while under ordinary circumstances it might be well enough to proceed directly to such an investigation, since there is no better way of proving that certain groups of phenomena conform to law than by pointing out the law to which they conform, nevertheless in the present case I think it desirable to preface the inquiry with a brief discussion of one or two logical and psychological truths — truths of method and of doctrine — which lie at the basis of sociology. In our survey of the simpler sciences, no such preface was called for. In beginning to treat of biological truths, we did not deem it necessary to prove that waste and re-

pair proceed according to immutable laws, or to forestall possible cavils by declaring that, although we cannot predict our states of health from week to week, nevertheless organic phenomena are not the sport of chance. It is otherwise in sociology, which is a new science, encumbered with many popular misconceptions, and regarded with an evil eye by theologians, — persons who profess great devotion to the interests of advancing knowledge in general, while the particular advance in knowledge at any time going on somehow never happens to be the one which they think fit to regard with favour. Of each new trophy which Science has from time to time laboriously won, these opponents have hastened to declare, "Behold, it is the last!" Though the phenomena presented by the heavenly bodies, by the surface of the earth, and by the life which covers the earth, have one after another, in spite of vehement theological protest, been made the subjects of science,[1] it is still stoutly maintained that the results of human volitions can never become amenable to scientific treatment. Here, it is cried, on the threshold of sociology we must take our final stand,

[1] "Als Pythagoras seinen berühmten Lehrsatz entdeckte, opferte er den Göttern eine Hekatombe, d. h. ein Opfer von hundert Stieren. Seitdem brüllen alle Ochsen, so oft eine neue Wahrheit entdeckt wird." Büchner, *Die Darwin'sche Theorie*, p. 288.

and insist, in the interests of religion and morality, that although all other events may occur in regular sequence, nevertheless in human affairs there is no such sequence. The arguments by which it is sought to establish this desperate proposition are based partly on those facts which are assumed to prove the freedom of the will, partly on the endless diversity and complexity of human affairs. Concerning this latter class of considerations, I may say here that they are at once irrelevant and inconclusive. Irrelevant, since even if it were to be granted — which it is not — that the extreme intricacy of social phenomena may prevent our discerning the order of their sequence, this would prove, not that there is no sequence, but that our vision is limited. Inconclusive, because from the nature of the case, other things being equal, complex phenomena cannot be generalized until the simpler phenomena which they involve have been mentally reduced to orderly succession. As we shall again have occasion to notice, the laws of social life could not be discovered until the sciences of biology and psychology had gone far toward formulating the laws of physical and psychical life in general. But the misconceptions which cluster about this subject are so numerous that they may best be eliminated by a somewhat detailed controversy. Let us examine the argument from complexity,

as presented by Mr. Froude; and afterwards the argument from the assumed lawlessness of volition, as presented by Mr. Goldwin Smith.

Mr. Froude begins [1] by dogmatically denying that there is or can be such a thing as a science of history. There is something incongruous, he says, in the very connection of the two words. "It is as if we were to talk of the colour of sound, or the longitude of the rule-of-three." But he carries on the thought in a way that shows plainly his reluctance to grapple fairly with the problem. In his next sentence he says, "where it is so difficult to make out the truth on the commonest disputed facts in matters passing under our very eyes, how can we talk of a science in things long past, which come to us only through books?" Now to reason like this is merely to shrink from the encounter. For the question is, not whether the science is difficult, but whether it is possible. Mr. Froude sets out to show that there can be no such science, and his first bit of proof is that, if there is such a science, it must be far more difficult than any other; a position which we may contentedly grant. Let us follow him a step farther. "It often seems to me as if history were like a child's box of letters, with which we can spell any word we please. We have only to pick out such letters as we want, arrange

[1] *Short Studies on Great Subjects*, vol. i.

them as we like, and say nothing about those which do not suit our purpose." And what does all this amount to? Is this Mr. Froude's idea of historical investigation? Why, the same thing may be done in any science. We have only to pick out all the facts on one side, and blink all the facts on the other side, to prove the veracity of every oracle, soothsayer, and clairvoyant that ever existed, the validity of every paltry omen, the credibility of every crazy notion of alchemy or judicial astrology. In this way we may prove that the homœopathist always saves his patient, while the allopathist always kills him; or *vice versa*. And it was in this way that the phrenologists erected their pseudo-science. By following this method, also, it becomes easy to prove that Henry VIII. was an exemplary husband. It is in this way that every incorrect or inadequate hypothesis in physical science or in history has arisen, and gained temporary recognition. Supposing Tycho Brahe had said to his Copernican antagonists, "Astronomy is like a child's box of letters; if we take out what we want and let the rest go, we can spell whatever we please; I spell out the Ptolemaic hypothesis, and will therefore abide by it;" he would have been talking much after the manner of Mr. Froude. It is true, as Mr. Froude further says, that one philosopher believes in progress, a second in retro-

gression, and a third, like Vico, in ever-recurring cycles. But is this because the facts are undecipherable, or because the investigation is one-sided? Because Agassiz still believes organic species to be fixed, while almost all other naturalists believe them to be variable in character, are we to infer that there is no science of biology? In such unworthy plight does Mr. Froude retreat before the problem he has encountered. He starts to show us that a science of history is as ridiculous an impossibility as a scarlet B-flat or a westerly proportion; and he ends by mildly observing that history is a difficult subject, in which a series of partial examinations may bring forth contradictory conclusions!

The next bit of inference concerns us more intimately. "Will a time ever be when the lost secret of the foundation of Rome can be recovered by historic laws? If not, where is our science?" Just where it was before. The science of history has nothing to do with dates, except to take them, so far as they can be determined, from the hands of historical criticism. They are its data, not its conclusions. As Mr. Morley reminds us, we do not dispute the possibility of a science of meteorology because such a science cannot tell us whether it was a dry or a wet day at Jericho two thousand years ago. Facts like these show us that sciences dealing

with phenomena which are the products of many and complex factors cannot hope to attain that minute precision which is attained by sciences dealing with phenomena which are the products of few and simple factors. They show that sociology cannot, like astronomy, be brought under the control of mathematical deduction. But it was not necessary for Mr. Froude to write an essay to prove this.

But, continues Mr. Froude, " can you imagine a science which would have *foretold* such movements as " Mohammedanism, or Christianity, or Buddhism? To the question as thus presented, we must answer, certainly not. Neither can any man foretell any such movement as the typhoid fever which six months hence is to strike him down. If the latter case does not prove that there are no physiologic laws, neither does the former prove that there are no laws of history. In both instances, the antecedents of the phenomenon are irresistibly working out their results ; though in both cases they are so complicated that no human skill can accurately anticipate their course. But to a different presentment of Mr. Froude's question, we might return a different answer. There is a sense in which movements like Mohammedanism, or Buddhism, or Christianity, could not have been predicted, and there is a sense in which they could have been. What could not have been

predicted was the peculiar character impressed upon these movements by the gigantic personalities of such men as Mohammed and Omar, Sakyamuni, Jesus, and Paul. What could have been predicted was the general character and direction of the movements. For example, as I shall show in the following chapter, Christianity as a universal religion was not possible until Rome had united in a single commonwealth the progressive nations of the world. And when Rome had accomplished this task, it might well have been predicted that before long a religion would arise which should substitute monotheism for polytheism, proclaiming the universal fatherhood of God, and the universal brotherhood of men. I admit that such a prediction could have been made only by a person familiar with scientific modes of thought not then in existence; but could such a person have been present to contemplate the phenomena, he might have foreseen such a revolution in its main features, as being an inevitable result of the interaction of Jewish, Hellenic, and Roman ideas. I am inclined to think he might have foreseen that it would arise in Palestine, that its spread would be confined to the area covered by Roman civilization, and that its work would for a long time be most thorough in the most thoroughly Romanized regions.

We do not need, however, to insist upon this

point. For in none of the concrete sciences is there anything like thorough and systematic prevision, save in astronomy ; and even in astronomy our foresight becomes precarious as soon as we pass beyond the solar system, and begin to inquire into the results of the mutual gravitation of the innumerable stellar bodies. We know that our sun is rushing, with immense velocity, toward the constellation Hercules ; but we cannot yet trace his orbit, as Kepler traced the orbit of Mars. When we come to biology and psychology, the power of accurate prevision is very small; yet no one denies that the phenomena of life and intelligence conform to fixed and ascertainable laws. In sociology we must expect still less ability to predict. The truth is, as Comte acutely pointed out, that while in the simpler sciences our object is gained if we can foretell the course of phenomena so as to be able to regulate our actions by it, in the more complex sciences our object is gained when we have generalized the conditions under which phenomena occur so as to be able to make our volitions count for something in modifying them. We cannot modify astronomic phenomena, but we can predict them. We cannot predict, save to a limited extent, biologic phenomena ; but knowing more and more thoroughly the conditions under which they occur, we can more and more skilfully modify them so as to

ensure health or overcome disease. And obviously even this limited ability to modify the phenomena implies a certain amount of prevision, quite enough to justify us in asserting that the phenomena conform to law. The case is similar in sociology. Though we may not be able definitely to predict a given political revolution, we may nevertheless understand the general movement of affairs and the effects which certain kinds of legislation are likely to produce, so as to hasten a desired result or avert social mischief. Upon this possibility are based all our methods of government and of education. And, as in biology, this ability to modify the phenomena proves that the phenomena occur in some fixed order of sequence. For if there were phenomena without any definite order of sequence, we could neither predict nor modify them; and where there is a definite order of sequence, there is, or may be, a science.

Now in denying that there is or can be a science of history, Mr. Froude, if he means anything, means that social affairs have no fixed order of sequence, but are the sport of chance. Either Law or Chance — these are the only alternatives, unless we were to have recourse, like the Mussulman, to Destiny, an illegitimate third idea, made up of the other two misconceived and mutilated in order to fit together. But for the modern thinker there is no middle course.

It is either symmetry or confusion, law or chance, and between the two antagonist conceptions there can be no compromise. If the law of causation is universal, we must accept the theory of law. If it has ever, in any one instance, been violated, we may be excused for taking up with the theory of chance. Now we know that all the vast bodies in this sidereal universe move on for untold ages in their orbits, in strict conformity to law. In conformity to law, the solar system in all its complexity has grown out of a homogeneous nebula; and the crust of the cooling earth has condensed into a rigid surface fit for the maintenance of organic life. Out of plastic materials furnished by this surface and the air and moisture by which it is enveloped, organic life has arisen and been multiplied in countless differing forms, all in accordance with law. Of this aggregate of organic existence, man, the most complex and perfect type, lives and moves and has his being in strict conformity to law. His periods of activity and repose are limited by planetary rotations. His achievements, physical and mental, are determined by the rate of his nutrition, and by the molecular structure and relative weight of the nervous matter contained in him. His very thoughts must chase each other along definite paths and contiguous channels marked out by the laws of association. Throughout these various phe-

nomena, already generalized for us by astronomers, geologists, biologists and psychologists, we know that neither at any time nor in any place is law interfered with, — that yesterday, to-day and forever, the effect follows the cause with inevitable and inexorable certainty. And yet we are asked to believe that in one particular corner of the universe, upon the surface of one little planet, in a portion of the organism of one particular creature, there is one special phenomenon called volition, in which the law of causation ceases to operate, and everything goes helter-skelter!

Such is the demand which Mr. Froude makes upon our powers of acquiescence, and such is the theory which Mr. Goldwin Smith, in the interests of theology, pronounces it unphilosophical, if not impious, for us to reject. Of the Science of History, Mr. Smith asserts that "it extinguishes all sympathy;" it "must put an end to self-exertion;" it "would dissolve the human family;" it makes man the most helpless of animals, no better in fact than "a beast or a blade of grass;" it degrades humanity to mere clay; it establishes "a strange contradiction between our outward observation and our inward consciousness;" it makes us "render up our personality," and become "a mere link in a chain of causation, a mere grain in a mass of being;" it builds up, "with much exultation,"

an "adamantine barrier of law" — whatever that may be — between man and the source of all goodness; and, to crown all it tells us that "conscience is an illusion," and prevents our having any "rule of right action."[1]

Hard words are as powerless to overthrow as to establish a philosophical theory. In scientific inquiry the ability to weigh evidence goes for much, but facility in declamation goes for little. And to any one who has been brought up amid scientific pursuits, there is but little that is instructive or edifying in the fervid rhetoric of a writer who, in attacking a disagreeable doctrine, prefers to stigmatize it as disagreeable, rather

[1] *Lectures on the Study of History*, pp. 63, 67, 48, 82, 85, 87, 59. Far abler men than Mr. Smith or Mr. Froude have in like manner allowed their feelings to run away with them when treating of this question. "Not the picture of a man; but the representation of an automaton that is what it cannot help being; a phantom dreaming what it cannot but dream; an engine performing what it must perform; an incarnate reverie; a weathercock shifting helplessly in the winds of sensibility; a wretched association-machine, through which ideas pass linked together by laws over which the machine has no control; anything, in short, except that free and self-sustained centre of underived, and therefore responsible activity, which we call Man;" — such, says Professor Ferrier, is "the false representation of man which philosophy invariably and inevitably pictures forth whenever she makes common cause with the natural sciences." *Lectures and Philosophical Remains*, vol. ii. p. 195. Verily the free-will question is a great opener of the flood-gates of rhetoric!

than to show that the evidence is against it. Nevertheless beneath the emotional assertions just quoted there lies a complicated theoretical misconception, the character of which it is worth our while to examine. The well-worn argument is that unless the human will were "free," there could be no responsibility, and therefore no morality; that if volitions are caused, even though it be by our own desires, we are all in a condition similar to that of the man who has made a promise under duress, to whom neither praise nor blame can justly be attached for the manner in which his promise is kept.

It is popularly supposed that there is something very forcible in this argument; and that, when coupled with the opposing arguments drawn from such sequences as are easily traceable among human affairs, the result is a puzzle which must forever remain insoluble. The problem of free-will has been described by poets, and is customarily regarded, as the most difficult problem which can occupy human attention; and we frequently hear it said that it can never be completely solved. But in reality all this perplexity is the result of the desperate muddle into which metaphysics has brought the subject. Strip the question of the peculiar metaphysical jargon in which it is usually propounded, restate it in precise scientific language, and it becomes a very easy question to answer. Would that

science presented none more difficult! Confused and inaccurate verbiage is responsible for the chronic disputation upon this subject. Nowhere else is Berkeley's complaint so thoroughly applicable, that in dealing with metaphysics men first kick up a dust and then wonder why they cannot see through it. Those who have come to regard the question from a purely scientific point of view also regard it as thoroughly settled; and the need for refuting such arguments as the one above cited, they class among the needs, too often thrust upon us, of refuting fallacies already thrice exploded. In illustration of this, let us notice the theory which the free-will argument implies concerning the nature of volition.

The theory implies that over and above particular acts of volition, there is a certain entity called "The Will," which is itself a sort of personage within the human personality. This entity, called "The Will," is supposed to have desires and intentions of its own, which the causationists are supposed to declare constantly liable to be frustrated by external agencies. In opposition to this imaginary heresy, it is asserted that this autocratic Will is "free," and, sitting in judgment over "motives," may set aside the stronger in favour of a weaker, or may issue a decree in defiance of all motives alike. Some such crude conception as this is implicitly

conveyed by every statement which, alluding to the Will as an entity, ascribes "freedom" to it. Only by means of such a conception can the phrase "freedom of the Will" be shielded from the imputation of nonsense. Only thus can the argument above cited be regarded as relevant to the subject in dispute. For if Will be not conceived as an entity acting under conditions, then no comparison can be made between caused volition and constrained behaviour. If instead of "The Will" we look at the act of willing, — which is not an entity, but a dynamic process, — then it becomes absurd to talk of this act as being either free or not free, and we must seek for some other word than "freedom" by which to designate its alleged want of causal connection with preceding psychical states.

Now the tendency to erect relations and processes into entities is a tendency which modern metaphysics has inherited from a mischievous mode of thought current in ancient times and rather loosely known as "Realism." Among metaphysicians, unused to the habits of thought which science nurtures, the tendency is an almost irresistible one. Civilization, for example, is obviously a *process*, but Dr. Whately continually speaks of it as if it were a *thing* which could be handed about from one nation to another, or hidden away for a time in some dark corner. And upon this amusing misconception he builds a

wonderful theory, which, however, it is not worth while for any busy man to stop and refute. It is in a similar way, and owing to the same realistic tendency, that there has arisen the conception of such an entity as "The Will," the existence of which modern psychology does not recognize any more than it recognizes the *lapidity* of stones or the *ubication* of points in space. Modern psychology is concerned only with the *process of will*, or volition. As Dr. Maudsley observes, "it is not man's function in life to think and feel only: his inner life he must express or utter in action of some kind — in word or deed. Receiving impressions from nature, of which he is a part, he reacts upon nature intelligently, modifying it in a variety of ways. . . . As the spinal cord reacts to its impressions in excito-motor action, and as the sensory centres react to their impressions in sensori-motor action, so, after the complex interworking and combination of ideas in the hemispherical ganglia, there is in like manner a reaction or desire of determination of energy outwards, in accordance with the fundamental property of organic structure to seek what is beneficial and to shun what is hurtful to it. It is this property of tissue that gives the impulse which, when guided by intelligence, we call volition; and it is the abstraction from the particular volitions which metaphysicians personify as

the Will. . . . Physiologically we cannot choose but reject the Will: volition we know, and will we know, but the Will, apart from particular acts of volition or will, we cannot know. To interpose such a metaphysical entity between reflection and action thereupon would bring us logically to the necessity of interposing a similar entity between the stimulus to the spinal cord and its reaction. Thus instead of unravelling the complex by help of the more simple, we should obscure the simple by speculations concerning the complex."[1] As scientific inquirers, "we have to deal with volition as a function of the supreme centres, following reflection, varying in quantity and quality as its cause varies, strengthened by education and exercise, enfeebled by disease, decaying with decay of structure, and always needing for its outward expression the educated agency of the subordinate motor centres. We have to deal with will, not as a single undecomposable faculty unaffected by bodily conditions, but as a result of organic changes in the supreme centres, affected as certainly and seriously by disorder of them as our motor faculties are by disorder of their centres. Loss of power of will is one of the earliest and most characteristic symptoms of mental derangement; and whatever may have been thought in times past, we know well now that the loss is not the work of

[1] *Body and Mind*, pp. 22, 23.

some unclean spirit that has laid its hands upon the Will, but the direct effect of physical disease."

Volition is, accordingly, that transformation of feeling into action which is attended by a conscious comparison of impressions, and which involves nutritive changes in the cerebrum or cerebellum, or in both. As we saw in the preceding chapter, the sequence of actions upon impressions is either reflex or instinctive, and in either case automatic, so long as the nervous energy liberated by the impression is instantly discharged through a completely permeable channel or set of channels. But in those higher organisms in which an immensely varied experience has established innumerable complex systems of less permeable channels, there intervenes between the liberation of energy in the brain and its discharge upon the motor centres a period during which there is a tension between various nerve currents, each seeking to discharge itself along the most permeable lines of transit. We saw also that this period of tension is a period of conscious deliberation, involving conscious reflection, and feelings of desire or aversion. And these views turned out to be justified by the fact that as soon as the frequent repetition of any given set of experiences has rendered all the transit lines involved in the case completely permeable, so that there is no longer any

appreciable period of tension, then the acts once conscious and voluntary become involuntary and automatic.

Now the state of consciousness called Desire is accompanied by a nascent excitement of the nerve fibres distributed upon the muscular apparatus whose activity is requisite for the attainment of the desired object. There is a tendency to go through with the movements needful for realizing the desire; and this tendency, unless neutralized by an antagonist tendency, must end in action. In the language of dynamics, tension, when not counteracted by opposing tension, must pass into *vis viva*. This passage of nervous tension into nervous *vis viva* constitutes *volition*, which may for practical purposes be regarded indifferently as the final stage of emotion or as the initial stage of action.

Passing from the case in which a single desire is operative, let us briefly consider the special case of two conflicting desires, where the gratification of the one is incompatible with that of the other. In this case, two groups of motor nerves are nascently excited. Here there are two opposite tensions, and the resulting action will depend on their comparative strength. If they exactly neutralize each other, as in the hypothetical case of the ass between the two bundles of hay, no volition will ensue. But in a complex aggregate, like the human or animal

organism, such a state of equilibrium cannot be of long continuance. Sooner or later — either from the greater vividness with which one of the desired objects is mentally realized, or from any one of a thousand other disturbing circumstances down to those of a purely physical nature, — one desire will become stronger than the other. And instantly thereupon, the surplus nervous tension remaining after the weaker desire is neutralized will pass into nervous *vis viva;* or, in other words, volition will take place.

The opposing tension need not, however, have desire for its concomitant. It may be furnished by the mere inertia of the nervo-muscular system; as when a man, wishing to do something which requires exertion, is too weary to do it. Weariness implies a diminution in the total amount of contractile force — a state in which a tension greater than ordinary is obviously required for the initiation of muscular motion. Conversely, the originating tension need not always be supplied by desire, but may be consequent upon vivacity, which is the presence of a superfluous amount of vital energy; as exemplified alike in the morning frolics of an infant, in the singing of birds, and in the gambols of a dog when released from his kennel.

Cases as simple as those here treated occur no doubt with comparative infrequency. Usually a great number of motives, indefinitely

complex and variable in their mutual combinations and oppositions, are simultaneously operative. But however numerous or complicated the forces at work, from whatever source the motives to action or inaction arise, whatever be the nature of the incentives to one kind of conduct or to some other kind, it is equally true that the result depends upon their comparative strength. Indeed since forces can be measured only by their effects, to say that of two conflicting motives one is followed by volition, is to call that motive the stronger one. "Our only evidence of excess of force is the movement it produces;" and when the ancient engineer wished to ascertain the comparative power of a couple of catapults, he had no alternative but to see which would hurl its stone to the greater distance. To say explicitly that volition does not follow the strongest motive, is to say implicitly that motion does not always follow the line of least resistance; which is to deny the persistence of force.

Volition being accordingly regarded as the process whereby feeling initiates action, it becomes evident that the term "free" is no more applicable to it than the term "copper coloured." As Mr. Bain observes, "The designation 'liberty of choice' has no real meaning, except as denying extraneous interference. If I am interfered with by another person compel-

ling me to act in one way, then it may be said, intelligibly enough, that I have not liberty of choice. But as between the different motives of my own mind, there is no meaning in the use of the word 'liberty.' Various motives — present or prospective pleasures and pains — concur in urging me to act. The result of the conflict shows that one group is stronger than another, and that is the whole case."[1] Or, as M. Littré has still more forcibly reminded us, the term "liberty," as applied to volition, *means* the power of obeying the strongest motive. When that power is interfered with, by paralysis or insanity, or the constraint exercised by other persons, then we may truly say that we are deprived of free-will and of responsibility. But so long as circumstances allow volition to follow the strongest motive, then we truly say that we are free and responsible for our actions. Thus the tables are completely turned, and much of the current disputation on this subject is reduced at once to unmeaning verbiage. The popular arguments in favour of "freedom" are seen to be as palpable cases of *ignoratio elenchi* as are those daily urged against the development hypothesis. By a scientific definition of Will, the assertion of freedom is set aside as irrelevant, leaving behind the assertion of non-causation. That this too is virtually disposed

[1] Bain, *The Emotions and the Will*, 1st edition, p. 550.

of by the same definition scarcely needs pointing out. Yet for the sake of still greater clearness, our present results may fitly be supplemented by a new class of considerations.

That volitions differ from all other phenomena by their capability of occurring without any cause is the opinion of the free-will philosophers; and Mr. Smith, in criticising the contrary opinion, remarks that "if comets formed their own future" (*i. e.* were endowed with volition), "they would be rather embarrassing subjects of science." Without attempting to decipher the vagaries in which these cosmical bodies might in such case take it upon themselves to indulge,[1] it will be enough for my present purpose to point out some of the shoals on which the free-will doctrine must land its defenders. If volitions arise without cause, it necessarily follows that we cannot infer from them the character of the antecedent states of feeling. If, therefore, a murder has been committed, we have *a priori* no better reason for suspecting the worst enemy than the best friend of the

[1] In point of fact a comet does "form its own future" in the same way that a man does. The state of a heavenly body at any given moment is a product, partly of the forces, molar and molecular, with which it was endowed at the preceding moment, and partly of the forces simultaneously exerted upon it by environing heavenly bodies. The case of human volition differs from this in nothing save the number and complexity, and consequent relative incalculableness, of the forces at work.

murdered man. If we see a man jump from a fourth-story window, we must beware of too hastily inferring his insanity, since he may be merely exercising his free-will; the intense love of life implanted in the human breast being, as it seems, unconnected with attempts at suicide or at self-preservation. We can thus frame no theory of human actions whatever. The countless empirical maxims of every-day life, the embodiment as they are of the inherited and organized sagacity of many generations, become wholly incompetent to guide us; and nothing which any one may do ought ever to occasion surprise. The mother may strangle her first-born child, the miser may cast his long treasured gold into the sea, the sculptor may break in pieces his lately finished statue, in the presence of no other feelings than those which before led them to cherish, to hoard, and to create.

To state these conclusions is to refute their premise. Probably no defender of the doctrine of free-will could be induced to accept them, even to save the theorem with which they are inseparably wrapped up. Yet the dilemma cannot be avoided. Volitions are either caused, or they are not. If they are not caused, an inexorable logic brings us to the absurdities just mentioned. If they are caused, the free-will doctrine is annihilated. No help is afforded by the gratuitous hypothesis that there is a connec-

tion between the act and the motive, which yet is not a causal connection. Such connection, if it exist, must be a case either of conditional invariable sequence, or of unconditional invariable sequence. On the first supposition, we have a case like the succession of day and night, in which both terms of the sequence are conditioned upon a third fact; so that here we do not escape causation. The second supposition is but an assertion of causation in other words. While to take refuge in the postulate that this assumed connection is a case of variable sequence is to affirm and deny connection in the same breath.

But it is said that consciousness declares the Will to be free; and therefore that any attempt to disprove its freedom by reasoning is suicidal, since all such reasoning must end by impugning the veracity of that consciousness on which its own data are ultimately based. An ingenious argument truly, the conclusion whereof would be more readily admitted if its premise were true. Consciousness, which is so confidently appealed to as establishing by its infallible verdict the doctrine of free-will, in fact says nothing about the matter. That volitions are uncaused is a proposition altogether too indirect for consciousness to sit in judgment upon, and it can neither be proved nor disproved by simple introspection. It would have been equally

appropriate for the mediæval astronomer to appeal to consciousness as testifying to the revolution of the sun about the earth. As Mr. Bain observes, "it is a great stretch of asseveration to call the construction of an enormous theory an act of consciousness so simple that we cannot make a slip in performing it."[1] Consciousness tells us only that we will. By observation and experience — not by the simple and direct interrogation of consciousness — we know that, circumstances permitting, our volitions may be accomplished. With the exception, therefore, of those theological fatalists who assert that human actions are determined by an external constraining power, it is the universal opinion that men can voluntarily determine their own actions; and this is just what the much-abused testimony of consciousness amounts to. This is all that it means to any one not mystified by metaphysics; the non-causation of volitions being a theorem so far from obvious to a great many men, that it requires considerable explanation to make them understand it. By the testimony of consciousness, as thus interpreted, the assertors of the lawlessness of volition are not helped in the least. The question at issue between them and their opponents is, not whether the actions of men are normally free, but whether their freedom is consistent with their being caused. The

[1] *The Emotions and the Will,* 1st edition, p. 563.

assertors of "Free-Will" maintain that causation is inconsistent with liberty."[1] The so-called necessarians assert that liberty and causation are quite consistent with each other. To which we must now add, that it is not causation, but the absence thereof, which is as incompatible with liberty as it is with law.

For the causationist, believing that volition invariably follows the stronger motive, endeavours to increase the relative strength of all those emotions whose outcome is virtuous and upright conduct, while he strives to weaken those feelings whose tendency is toward base and ignoble conduct. Knowing that by continual indulgence desire is reinforced, while by constant

[1] "The law of bondage throughout the universe is the law of cause and effect. In the violation, then, of this law, true freedom must consist." Ferrier, *Lectures and Philosophical Remains*, vol. ii. p. 255. One might expect such a remark as this from Mr. Goldwin Smith, who speaks of being "bound by the chain of certain causation;" but from so acute a thinker as Professor Ferrier, it is surprising. To adopt, in a somewhat altered sense, Kant's happy illustration, — the spectacle of a bird denouncing as an encumbrance the air by which alone it is enabled to fly would be a fitting parallel to the spectacle of those philosophers who decry that regularity of sequence through which alone has "freedom" any meaning. As Lessing long ago said, with well-bestowed contempt, "Le beau privilège d'être soumis à une puissance aveugle qui ne suit aucune règle! *En serait-je moins le jouet du hasard parce que ce hasard résiderait en moi?*"

repression it is enfeebled, he applies this knowledge to the control of his will and the discipline of his character. But on the theory that volitions are causeless, all methods of self-discipline become of no avail. If they are powerless to influence action, it is of small practical importance whether noble and sympathetic or base and selfish motives are prevalent; and the moral distinction between them loses most of its significance. Why, asks Mr. Smith, "is a Philip II. more the subject of moral disapprobation than the plague?" Why, indeed, unless his atrocious crimes are to be interpreted as the necessary outgrowth of a character wherein good motives were impotent and bad motives all-powerful. Were volition self-determining, then similar acts might have been committed by a Washington or a Borromeo. Obviously there would be little use in laboriously schooling our desires to virtue, if at any moment in spite thereof some uncaused volition might bring forth from us a detestable deed. It is therefore not the doctrine of causation, but the so-called free-will doctrine, that, if true, would "put an end to self-exertion," and deprive us of every "rule of right action." Since self-control, and therefore liberty, is impossible unless volition is determined by desire, it is the latter doctrine — not the former — which is really inconsistent with the assertion of human freedom, which takes from us the

dignity of responsibility, and makes man the sport of a grotesque and purposeless chance.

In truth, the immediate corollaries of the free-will doctrine are so shocking, not only to philosophy but to common-sense, that were not accurate thinking a somewhat rare phenomenon it would be inexplicable how any credit should ever have been given to such a dogma. This is but one of the many instances in which, by the force of words alone, men have been held subject to chronic delusion. The libertarian doctrine has obtained currency because it has talked loudly of human freedom, with which, nevertheless, a brief analysis proves it to be incompatible. Substitute for the unmeaning phrase "freedom of the Will" the accurate phrase "lawlessness of volition," and the theory already looks less plausible. In place of the vague and ambiguous word "necessity," write the clear and definitely connotative word "causation," and the scientific theory at once loses its imaginary terrors. The titles with which the free-will doctrine decorates itself, and those with which it brands its opponent, are alike "question-begging epithets." They serve to prejudge the point at issue.

Not content with the overwhelming prestige which its name thus gives it, the free-will doctrine seeks to follow up its advantage by identifying its antagonist with Asiatic fatalism; a

confusion of ideas like that under which Mr. Bounderby laboured, when unable to see the difference between giving workmen their just dues, and feeding them with turtle-soup out of a gold-lined spoon. To say that actions dependent on volition will take place whenever the essential conditions are present, and to say that they will take place even if the conditions are absent, are by free-will theorists held to be one and the same assertion![1] Fatalism is, however, much more closely akin to their own doctrine. Each ignores causation; each is incompatible with personal freedom; the only difference between them being that the one sets up Chance, while the other sets up Destiny, as the arbiter of human affairs. And while each doctrine is theoretically held by large bodies of men, each in practice is habitually contradicted by its upholders. The defenders of free-will, who in practice are obliged to admit a certain connection between acts and motives, and the

[1] "It is owing to the very general misconception of the nature of Law that there arises the misconception of Necessity; the fact that events arrive irresistibly whenever their conditions are present is confounded with the conception that the events must arrive whether the conditions be present or not, being fatally predetermined. Necessity simply says that whatever is is, and will vary with varying conditions. Fatalism says that something *must be*; and this something cannot be modified by any modification of the conditions." Lewes, *Problems of Life and Mind*, vol. i. p. 309.

Arab fatalists, among whom the saying is current that "when Allah wills an event, he prepares the causes beforehand," alike exemplify this. Though both agree in repudiating causation, both equally in their every-day maxims give evidence of an unconscious belief in its existence.

Having identified the causation theory with fatalism, it becomes all the easier for its opponents to accuse it of denying moral responsibility. Accordingly, when Mr. Buckle, following in the footsteps of Laplace, inferred from the regularity of the statistics of crime and suicide, marriages and dead-letters, that voluntary actions conform to law;[1] it was proposed by one of his reviewers that state governments should at once suspend judicial operations, and having ascertained from statistics the yearly number of murders, should forthwith hang a corresponding number of individuals, selected by lot from the community. To which suggestion the natural reply would have been, that if governments ever do adopt this singular course of administering justice, they will then be consistently acting on the belief that motives do not stand in a causal relation to volitions. If the volition can follow the weaker motive, the feelings which ordinarily deter from the commission of crime

[1] Buckle, *Civilization in England*, vol. i. pp. 20–30; Laplace, *Essai sur les Probabilités*, p. 76.

need not be strengthened by the fear of punishment.[1]

Thus do all the favourite arguments in behalf of the free-will hypothesis recoil upon its defenders. To adopt from barbarian warfare an ungraceful but expressive simile, they are like awkwardly thrown boomerangs which wound the thrower. Attempting, as the free-will philosophers do, to destroy the science of history, they are compelled by an inexorable logic to pull down with it the cardinal principles of ethics, politics, and jurisprudence. Political economy, if rigidly dealt with on their theory, would fare little better; and psychology would become chaotic jargon. That psychical actions,

[1] "The very reason for giving notice that we intend to punish certain acts, and for inflicting punishment if the acts be committed, is that we trust in the efficacy of the threat and the punishment as deterring motives. If the volition of agents be not influenced by motives, the whole machinery of law becomes unavailing, and punishment a purposeless infliction of pain. In fact it is on that very ground that the madman is exempted from punishment; his volition being presumed to be not capable of being acted upon by the deterring motive of legal sanction. The *free* agent, thus understood, is one who can neither feel himself accountable, nor be rendered accountable to or by others. It is only the *necessary* agent (the person whose volitions are determined by motives, and, in case of conflict, by the strongest desire or the strongest apprehension) that can be held really accountable, or can feel himself to be so." Grote, *Review of Mill's Examination of Hamilton's Philosophy*, p. 97.

and volitions among them, conform to law is the indispensable axiom of every science or philosophy which treats of the mind and its products, whether individually or socially embodied. He who asserts the contrary maintains "a form of the Manichæan doctrine of two principles . . . in which one principle, that of order, presides over the physical phenomena of the universe, and the other, that of disorder, over its moral phenomena."[1] As I have already said, no middle ground can be taken. The denial of causation is the affirmation of chance, and "between the theory of Chance and the theory of Law, there can be no compromise, no reciprocity, no borrowing and lending." To write history on any method furnished by the free-will doctrine would be utterly impossible. Mr. Smith tells us that "finding at Rome a law to encourage tyrannicide, we are certain that there had been tyrants at Rome, though there is nothing approaching to historical evidence of the tyranny of Tarquin." By drawing this inference he abandons his own principles, according to which the law in question might have originated without any cause except the self-determining will of some Roman legislator. And he is equally inconsistent in saying that "a nation may *have* to go through one stage of knowledge or civilization before it can reach

[1] W. Adam, *Theories of History*, p. 65.

another, but its going through either is still *free*." If by this it is meant that a nation's progress need not be due to constraint exercised over it by other nations, the statement is true, but it is one which no one has thought of disputing. But if it is meant that the latter of two successive stages of civilization is not caused by the former, the statement destroys itself. By admitting that "a nation may *have* to go through one stage of civilization before it can reach another," Mr. Smith gives up his case and concedes all which has ever been claimed by those who would construct a science of history. If there is a definite order of sequence among the stages of civilization, that order may sooner or later be formulated, and to formulate that order is to found sociology as a science. But if causation in history is denied, if each epoch is not determined by the preceding epoch, then the inference is inevitable that the French Revolution might have happened in the reign of Louis XI., or that the progress of Christianity might have been eastward instead of westward. Thus all conception of progress, as well as all conception of order, is at an end. Thus the vast domain of History, numbering among its component divisions the phenomena of Language, Art, Religion, and Government, the products of social activity as well as the phases of social progress, becomes an unruly chaos, a Tohu-va-

Bohu, where event stumbles after event, and change jostles change, without sequence and without law.

I think, therefore, we are quite justified in saying that, when stripped of the metaphysical jargon in which it is usually propounded, the question of free-will becomes an easy one to answer. Having laid the dust which metaphysicians have kicked up, we find our vision no longer obscured. From whatever scientific standpoint we contemplate the doctrine of the lawlessness of volition, we find that its plausibleness depends solely on tricks of language. The first trick is the personification of Will as an entity distinct from all acts of volition; the second trick is the ascription to this entity of "freedom," a word which is meaningless as applied to the process whereby feeling initiates action; and the third trick is the assumption that desires or motives are entities outside of a person, so that if his acts of volition were influenced by them he would be robbed of his freedom. Any one, however, who is not misled by these verbal quibbles, and who bears in mind that a person, psychologically considered, is nothing more than the sum of his conscious states, will perceive at once that when the desires or aversions determine the volitional acts, it is the person himself who determines them. We have accordingly seen that, since liberty of

choice means nothing if it does not mean the power to exert volition in the direction indicated by the strongest group of motives; and since all control over character is impossible unless desires and volitions occur in a determinate order of sequence; it is the doctrine of lawlessness and not the causationist doctrine which is incompatible with liberty and destructive of responsibility. The rhetoric which Mr. Goldwin Smith lavishes, on the strength of a set of misapplied phrases, might therefore be justly retorted upon him, on the strength of a psychologic analysis. And this, which is the conclusion of science, we have seen to be also the conclusion of common sense. Whatever may be our official theories, we all practically ignore and discredit the doctrine that volition is lawless. Whatever voice of tradition we may be in the habit of echoing, we do equally, from the earliest to the latest day of our self-conscious existence, act and calculate upon the supposition that volition, alike in ourselves and in others, follows invariably the strongest motive. And upon this ineradicable belief are based all our methods of government, of education, and of self-discipline. Finally, in turning our attention to history, we have found that the aggregate of thoughts, desires, and volitions in any epoch is so manifestly dependent upon the aggregate of thoughts, desires, and volitions in

the preceding epoch, that even the assertors of the lawlessness of volition are forced to commit logical suicide by recognizing the sequence. Thus, whether we contemplate volitions themselves, or compare their effects, whether we resort to the testimony of psychology or to the testimony of history, we are equally compelled to admit that Law is coextensive with all orders of phenomena and with every species of change.

It is hardly creditable to the character of the present age for scientific enlightenment that such a statement should need to be made, or that thirty-nine pages of critical argument should be required to illustrate it. To many this chapter will no doubt seem much like an elaborate attempt to prove the truth of the multiplication table. Nevertheless where such a blinding metaphysical dust has been raised, a few drops of the cold water of common sense may be not only harmless but useful. Having thus done somewhat to clear the air, we may next proceed to point out the way in which social changes conform to the Law of Evolution.

CHAPTER XVIII

THE EVOLUTION OF SOCIETY[1]

ANY attempt to discover the laws to which social changes conform must run great risk of being frustrated by the mere immensity of the mass of details which the investigator strives to arrange in orderly sequence. Seemingly numberless as are the phenomena dealt with by the physical sciences, they bear no proportion, either in multitude or in variety, to the facts upon which the student of sociology must build his scientific theorems. Facts concerning man in his physical relations to soil, climate, food, and the configuration of the earth blend with facts concerning the intellectual and moral relations of men to each other and to the aspects of nature by which they are surrounded, making up a problem of such manifold complexity that it may well have long been deemed incapable of satisfactory solution. The fit ground for wonder is, indeed, not that we are as yet unable to arrive at accurate prevision amid such a diversified throng of phenomena, but that, considering the meagreness of our knowledge in

[1] [See Introduction, §§ 22, 23.]

many other departments, we should have been able to detect any uniformity whatever in human affairs, and having detected it, to explain it upon trustworthy scientific principles.

There is but one way to conduct such an intricate investigation securely to its final issue; and that is, to make extensive use of elimination as it is employed in the simpler sciences. "If without any previous investigation of the properties of terrestrial matter, Newton had proceeded at once to study the dynamics of the universe, and after years spent with the telescope in ascertaining the distances, sizes, times of revolution, inclinations of axes, forms of orbits, perturbations, etc., of the celestial bodies, had set himself to tabulate this accumulated mass of observations, and to educe from them the fundamental laws of planetary and stellar equilibrium, he might have cogitated to all eternity without arriving at a result." This lucid illustration, which I have cited from the introduction to Mr. Spencer's "Social Statics," suggests the proper method of approaching the investigation of complex phenomena. Minor perturbing elements must for a time be left out of consideration, just as the inequalities of motion resulting from the mutual attractions of the planets were at first passed over in the search for the general formula of gravitation. The discussion of endless minute historical details must

be reserved until the law of social changes has been deduced from the more constant phenomena, and is ready for inductive verification. A law wide enough to form a basis for sociology must needs be eminently abstract, and can be found only by contemplating the most general and prominent characteristics of social changes. The prime requisite of the formula of which we are in quest is that it should accurately designate such changes under their leading aspect.

Now by far the most obvious and constant characteristic common to a vast number of social changes is that they are changes from a worse to a better state of things, — that they constitute phases of Progress. It is not asserted that human history has in all times and places been the history of progress; it is not denied that at various times and in many places it has been the history of retrogression; but attention is called to the fact — made trite by long familiarity, yet none the less habitually misconceived — that progress has been on the whole the most constant and prominent feature of the history of a considerable and important portion of mankind.

Around this cardinal fact have clustered, as I just hinted, many serious misconceptions. The illustrious thinkers of the last century, who endeavoured to study human history from a scientific point of view, were unconsciously led into an error from which contemporary writers

have not as yet entirely freed themselves. The followers of Turgot and Condorcet were prone to regard progress as something necessary and universal. They attempted to account for it, much as Lamarck tried to explain organic development, as the continuous and ubiquitous manifestation of an occult, inherent tendency towards perfection. Subsequent literature exhibits many traces of this metaphysical conception. Thus Dr. Whately, in his edition of Archbishop King's discourses, asserts that "civilization is the natural state of man, since he has evidently a natural tendency towards it." Upon which it has been aptly remarked that, "by a parity of reasoning, old age is the natural state of man since he has evidently a natural tendency towards it." Indeed, as this comparison is intended to show, it is difficult to use such expressions as "natural state" and "natural tendency" without becoming involved in a confusion of ideas. And to ascribe progress to an inherent tendency, without taking into account the complex set of conditions amid which alone that tendency can be realized, is to give us an empty formula instead of a scientific explanation. Whether the individual will die young or reach old age, and whether the community will remain barbarous or become civilized, depends, to a great extent, upon environing circumstances; and no theory of progress can have

any value which omits the consideration of this fact. Mr. William Adam labours under the confusion of ideas here signalized, when he finds fault with Sir G. C. Lewis for upholding the doctrine of progress while admitting that certain races have never advanced in civilization. For this, Mr. Adam accuses him of virtually dividing mankind into two differently constituted races, of which the one possesses, while the other lacks, the inherent tendency toward perfection![1] He might as well maintain that because we admit that certain men are stunted, while others grow tall, we divide mankind into two differently constituted races, of which the one possesses, while the other lacks, the inherent tendency toward increase in size. Closely allied to this fallacy is that which associates lateness in time with completeness in development, and requires us to assume that nowhere at any time has there been a temporary retrogression. Thus Mr. Goldwin Smith appears to be confused by the impression that the temporary decline in the moral tone of English society after the Restoration of Charles II., is a fact inconsistent with the doctrine of a general progress. And Mr. Mansel still more preposterously declares that on the theory of progression we ought to regard the polytheism of imperial Rome as a higher form of religion than the earlier Hebrew wor-

[1] W. Adam, *Theories of History*, p. 87.

ship of Jehovah. While another form of the same confusion is to be seen in the attempts which writers imbued with the conception of progress often make, to coax the annals of the past into affirming the uninterrupted advance of civilization.

These examples show how vaguely the doctrine of progress has hitherto been apprehended. The fallacy of supposing civilization to have proceeded serially, or uniformly, or in consequence of any universal tendency, is nearly akin to the fallacy of classifying the animal kingdom in a series of ascending groups, — a fruitful source of delusion, which it was Cuvier's great merit to have steadily avoided. The theological habit of viewing progressiveness as a divine gift to man,[1] and the metaphysical habit of regarding it as a necessary attribute of humanity, are equally unsound and equally fraught with error. Until more accurate conceptions are acquired, no secure advance can be made toward discerning the true order of social changes. Far from being necessary and universal, progress has been in an eminent degree contingent and par-

[1] "It is impossible for mere savages to civilize themselves. . . . Consequently men must at some period have received the rudiments of civilization from a superhuman instructor." (!) Whately's *Rhetoric*, p. 94. A statement not altogether compatible with the one just quoted from the same author in the text.

tial. Its career has been frequently interrupted by periods of stagnation or declension, and wherever it has gone on, it has been forwarded, not by an inexplicable tendency or *nisus*, but by a concurrence of favourable conditions, external and internal. We must remember, moreover, as Sir Henry Maine reminds us,[1] that the communities which have attained to a conspicuous degree of civilization constitute a numerical minority of mankind. Contemporaneous with the rapidly advancing nations of Europe exist the sluggish nations of Asia, and the almost stationary tribes of Africa and Polynesia.

"Better fifty years of Europe than a cycle of Cathay."

So irregular, indeed, has been the march of civilization, that most stages of progress may be made the subject of ocular investigation at the present day.

In the science of history, therefore, old "means not old in chronology, but in structure: that is most archaic which lies nearest to the beginning of human progress considered as a development, and that is most modern which is farthest removed from that beginning."[2]

Nevertheless, in spite of the fact that the career of progress has been neither universal

[1] *Ancient Law*, p. 24; cf. Lewis, *Methods of Observation in Politics*, vol. i. p. 302.

[2] M'Lennan, *Primitive Marriage*, p. 9.

nor unbroken, it remains entirely true that the law of progress, when discovered, will be found to be the law of history. The great fact to be explained is either the presence or the absence of progress. And when we have formulated the character of progress, and the conditions essential to it, we have the key to the history of the stationary as well as of the progressive nations. When we are able to show why the latter have advanced, the same general principle will enable us to show why the former have not advanced. Though in biogeny we habitually view the process of natural selection as the process whereby higher organisms are slowly originated, the principle loses none of its importance because sundry species from time to time suffer deterioration, or remain stationary, or become extinct. When we know how it is that some species advance, we know how it is that other species do not advance. So, in the science of language, which is equally with sociogeny a science of development, — being, indeed, neither more nor less than a quite special province of sociogeny, — we rightly consider the main problem solved when we have explained the process of phonetic integration, by which languages ascend from the primary, through the secondary, to the tertiary stage of structure. It matters not that Chinese remains to this day a primary language, and that the numerical majority of languages have not

yet become tertiary by completely fusing together the component roots of their words. The process by which languages pass from a lower stage to a higher remains none the less the fundamental phenomenon to be investigated, and when we have generalized the conditions under which this process takes place, we can explain its absence as well as its presence. Now the case is the same with progress in society that it is with progress in language or in organic life. Whether manifested or not manifested in any particular community, progress is still the all-important phenomenon to be investigated. It is the one grand phenomenon, to explain the presence and the absence of which is to explain the phenomena of history. Just as the study of the languages which have advanced furnishes us the key for understanding those which have not advanced, so the study of the progressive communities furnishes us, as we shall see, the law of history; a law which, in its most general expression, covers the phenomena presented by the non-progressive communities likewise. Comte was therefore right in restricting the main current of his inquiry to the course of that civilization which began on the eastern shores of the Mediterranean, and has extended over Europe and a portion of America. The same plan will be pursued in the present chapter. Although incidental confirmation will be sought

in the history of the stationary communities, our main problem will be to formulate the law of progress from a comparison of the phenomena presented by the progressive communities.

But before we can fairly enter upon our task, it will be desirable for us to note the Factors of Progress with which we shall chiefly have to deal.

The prime factors in social progress are the Community and its Environment. The environment of a community comprises all the circumstances, adjacent or remote, to which the community may be in any way obliged to conform its actions. It comprises not only the climate of the country, its soil, its flora and fauna, its perpendicular elevation, its relation to mountain chains, the length of its coast line, the character of its scenery, and its geographical position with reference to other countries; but it includes also the ideas, feelings, customs, and observances of past times, so far as they are preserved by literature, traditions, or monuments; as well as foreign contemporary manners and opinions, so far as they are known and regarded by the community in question. Thus defined, the environment may be very limited or very extensive. The environment of an Eskimo tribe consists of the physical circumstances of Labrador, of adjoining tribes, of a few traders or travellers, and of the sum total of the

traditions received from ancestral Eskimos. These make up the sum of the conditions affecting the social existence of the Eskimos. The environment of the United States, on the other hand, while it comprises the physical conditions of the North American continent, comprises also all contemporary nations with whom we have intercourse, and all the organized tradition — political and ethical, scientific and religious — which we possess in common with all the other communities whose civilization originated in the Roman Empire. The significance of this increase of size and diversity in the environment will be explained presently.

Bearing in mind this definition of a social environment, — which I believe carries with it its own justification, — let us briefly notice the error committed by those writers who would fain interpret all the most important social phenomena as due, solely or chiefly, to physical causes. This is an error frequently committed by physiologists who try their hand at the investigation of social affairs, and who attempt to treat sociology as if it were a mere branch of biology. But this is not the case. As we have seen psychology to be an offshoot from biology, specialized by the introduction of inquiries concerning the relations of the percipient mind to its environment; we must similarly regard sociology as an offshoot from psychology, special-

ized by the introduction of inquiries concerning the relations of many percipient and emotionally incited minds to each other and to their common environment. As in biogeny all attempts to discover the law of organic development failed utterly so long as the relations of the organism to physical environing agencies were alone studied, and succeeded only when Mr. Darwin took into account the relations of organisms to each other; so still more inevitably in sociogeny must all our efforts fail so long as we consider merely the physiologic relations of a community to the country in which it dwells, and refuse to recognize the extent to which communities influence each other by means that are purely intellectual or moral. Doubtless the character of the physical environment is of importance, more especially, perhaps, in the earlier stages of civilization. No doubt civilization will first arise, other things equal, in a locality where food and shelter can be obtained with a medium amount of exertion; where nature is neither too niggard nor too lavish in the bestowal of her favours. No doubt there is a physical significance in the fact that civilization began, not in barren Siberia, or in luxuriant Brazil, but in countries like Egypt and Mesopotamia, which were neither so barren as to starve, nor so luxuriant as to spoil, the labourer. No doubt the Greeks owed much to

the extent of their coast line. No doubt — above all — the Mediterranean is justly sacred to the student of history as partly the civilizer of the peoples who upon its waves first courted adventure, and conducted commerce, and imparted to each other cosmopolitan sympathies which could never have been evoked but for some such intercourse. All this may be granted. But as civilization advances, the organized experience of past generations becomes to a greater and greater extent the all-important factor of progress. As Comte expresses it, in one of his profoundest aphorisms, the empire of the dead over the living increases from age to age. If we contemplate, from a lofty historical point of view, the relative importance of the factors in the environment of our United States, I believe we shall be forced to conclude that the victory of the Greeks at Marathon, the conquest of Gaul by Cæsar, the founding of Christianity, the defeat of Attila at Châlons and of the Arabs at Tours, the advent of the Normans in England, the ecclesiastic reforms of Hildebrand, the Crusades, the revolt of Luther, the overthrow of the Spanish Armada, and the achievements of scientific inquirers from Archimedes to Faraday, have influenced and are influencing our social condition to a far greater extent than the direction of the Rocky Mountains, or the position of the Great Lakes, or the

course of the Gulf Stream. Or if we inquire why the Spaniards are still so superstitious and bigoted, I believe we shall find little enlightenment in the fact that Spain is peculiarly subject to earthquakes, but much enlightenment in the fact that for eight centuries Spain was the arena of a life and death struggle between orthodox Christians and Moorish unbelievers.

The mention of Spain and earthquakes brings me to Mr. Buckle, a writer of marked ability, who, though he did not explicitly countenance the error I am here criticising, was nevertheless sometimes betrayed into committing it, as may be seen from the following passage: "The Arabs in their own country have, owing to the extreme aridity of their soil, always been a rude and uncultivated people, — for in their case, as in all others, great ignorance is the fruit of great poverty. But in the seventh century they conquered Persia; in the eighth century they conquered the best part of Spain; in the ninth century they conquered the Punjab, and eventually nearly the whole of India. Scarcely were they established in their fresh settlements, when their character seemed to undergo a great change. They who in their original land were little else than roving savages were now for the first time able to accumulate wealth, and therefore for the first time did they make some progress in the arts of civilization. In Arabia they

had been a mere race of wandering shepherds; in their new abodes they became the founders of mighty empires, — they built cities, endowed schools, collected libraries; and the traces of their power are still to be seen at Cordova, at Bagdad, and at Delhi." [1] To exhibit the utter superficiality of this explanation, we have only to ask two questions. First, if the Arabs became civilized *only* because they exchanged their native deserts for Spain, Persia, and India, why did not the same hold true of the Turks, when they exchanged their barren steppes for the rich empire of Constantinople? Though they have held for four centuries what is perhaps the finest geographical position on the earth's surface, the Turks have never directly aided the progress of civilization. Secondly, how was it that the Arabs ever came to leave their native deserts and to conquer the region between the Pyrenees and the Ganges? Was it because of a geologic convulsion? Was it because the soil, the climate, the food, or the general aspect of nature had undergone any sudden change? One need not be a profound student of history to see the absurdity of such a suggestion. It was because their minds had been greatly wrought upon by new ideas — because their conceptions of life, its duties, its aims, its possibilities, had been revolutionized by the genius

[1] *History of Civilization*, vol. i. p. 42.

of Mohammed. The whole phenomenon requires a psychological, not a physical explanation.

The environment in our problem must, therefore, not only include psychical as well as physical factors, but the former are immeasurably the more important factors, and as civilization advances their relative importance steadily increases. Bearing in mind these preliminary explanations, let us now address ourselves to the problem of social evolution, applying to the solution of it sundry biological principles established in previous chapters. We have first to observe that it is a corollary from the law of use and disuse, and the kindred biologic laws which sum up the processes of direct and indirect equilibration, that the fundamental characteristic of social progress is *the continuous weakening of selfishness and the continuous strengthening of sympathy*. Or — to use a more convenient and somewhat more accurate expression suggested by Comte — it is a gradual supplanting of *egoism* by *altruism*.

In the course of our inquiry into the causes of organic evolution, it was shown that all the processes coöperating in the development of higher from lower forms of life are in the widest and deepest sense processes of equilibration. The all-important truth was there demonstrated, that the progress of life on the earth has been

the continuous equilibration of the organism with its environment. In the maintenance of such an equilibrium life has been shown to consist. Accordingly, as we have seen, if the environment is suddenly and violently altered, the organism perishes; but when it is altered slowly, the organism slowly adapts itself to it. If the adaptation is not completed within a single generation, nevertheless a sufficient number of generations will complete it, just as the children and grandchildren of an emigrant become more and more thoroughly acclimated to their new home.

It is now to be shown that civilization is a slow process of breeding, of adaptation, of acclimatization — mental and moral, as well as physical, — of equilibration between the Community and the Environment. From age to age the environment is slowly but incessantly changing, and to its gradual changes the human race, embodied in communities, is continually adapting itself. As just observed, I am not referring to the physical environment alone; for in dealing with society we have to take into the account those psychological factors which have been shown to be by far the most considerable of all. Leaving out of the account all minor considerations of climate, food, or other physical circumstances, and looking at the psychological factors alone, we must admit that the en-

vironment is slowly but constantly changing. Every city that is built, every generalization that is reached, every invention that is made, every new principle of action that is suggested, alters in some degree the social environment, — alters the sum total of external relations to which the community must adjust itself by instituting new internal relations. The entire organized experience of each generation, so far as it is perpetuated by literature or oral tradition, adds an item to the environment of the next succeeding generation; so that the sum total of the circumstances to which each generation is required to conform itself is somewhat different from the sum total of circumstances to which the immediately preceding generation was required to conform itself. Thus the community, by the inevitable results of its own psychical activity, is continually modifying the environment; and to the environment, as thus continually modified, the community must reciprocally conform itself.

Now in the primitive, isolated, savage condition of mankind, what was the environment of each family or petty tribe, and what kind of emotional activity was it fitted to awaken? The unanimous testimony of scientific explorers, and others who have carefully studied the primitive phases of society, leaves us in little doubt as to this question. As Mr. M'Lennan

concisely expresses it, "The state of *hostility* is the normal state of the race in early times."[1] The environment of each little tribe is a congeries of neighbouring hostile tribes; and the necessity of escaping captivity or death involves continual readiness for warfare, and the continual manifestation of the entire class of warlike unsocial passions. While, on the other hand, the tribe is so small and homogeneous, that the opportunity for the exercise of sympathetic and social feelings is confined chiefly to the conjugal and parental relations. *Nevertheless in the exercise of these feelings in these relations are contained the germs of all subsequent social progress.* While without the limited sphere of the tribe all is hatred, revenge, and desire to domineer, within the limits of the tribe there is room for the rudimentary display of such feelings as loyalty, gratitude, equity, family affection, personal friendship, and regard for the claims of others. Since these feelings can be exercised only within family or tribal limits, it follows that the sphere for their exercise is relatively small; while as the hostile or egoistic feelings are conformed to the whole environment outside of the tribe, it follows that the sphere for their exercise is large. Hence, in this primitive state of society, the egoistic feelings, being oftenest called into play in the habitual occupations of life, will be most

[1] *Primitive Marriage*, p. 134.

active and will overbalance the altruistic feelings. While, on the other hand, as the kindlier sympathies are but nascent, even the altruistic feelings, such as they are, will be strongly tinged with egoism. The highest emotion attainable will be clannishness, and the highest rule of duty will be that which enjoins loyalty to the tribal patriarch. This is actually found to be the emotional and ethical condition of primitively organized communities, wherever they have been attentively studied by competent observers. Such, for example, has been the state of things existing from time immemorial among the American Indians, among the Polynesians, and among the Arabs of the desert; and these aspects of clan society, in a somewhat later stage, among the Scottish Highlanders, are well portrayed in several of the Waverley Novels.

Now what is it that chiefly determines the slow development of the altruistic feelings and the gradual atrophy of the egoistic feelings? Obviously it is the growth of the community in size and complexity, — the gradual enlargement of the area over which the altruistic feelings extend, and the gradual increase in the number of social situations which demand the exercise of those feelings. These conditions are partly fulfilled when the tribal community grows to a vast size, remaining structurally a tribe with a patriarchal head, — as was the case in ancient

Egypt, Assyria, Persia, and India, and as is still the case in China. But they are still better fulfilled when the community increases in the complexity of its internal relations, and, instead of remaining a tribe, becomes a federation of civic bodies, as in ancient Greece, or a single great civic body, uniting various tribal elements, as in ancient Rome. In each of these cases, the increased power of self-protection renders warfare less necessary and frequent, and the partial supplanting of the primitive predatory life by the occupations of agriculture and trade begins to make men more and more dependent on one another over a wider and wider area, and to create a whole class of interests to which warfare and destructiveness are more and more inimical. And in the latter case, where the community assumes a civic character, the rise of a genuine political life begins to make men operate on each other by indirect compulsion, or by persuasion, rather than by direct and brutal compulsion; and the highest attainable ethical feeling is no longer clannishness, but patriotism, in the exalted sense in which that word was understood by the Greeks and Romans. Note also that under the influence of this high ethical feeling, even military life loses its primitive purely egoistic character, and becomes a school of self-discipline and self-sacrifice, nourishing in no slight degree the altruistic feelings. If we compare

the campaigns of Marathon and Thermopylai with the expedition of a band of Highlanders in execution of a blood-feud, or with the excursion of a party of Red Indians on the warpath, we shall find no difficulty in realizing the force of these considerations.

But, like other phenomena in nature, our ethical feelings are not sharply marked off from each other. There is a selfish as well as a sympathetic side to patriotism (understanding the word always as the Greeks and Romans understood it.) At the one extreme, patriotism is akin to clannishness; at the other extreme, it becomes so wide as to resemble cosmopolitanism. As long as the purely civic structure of society lasted, the clannish element was distinctly present in patriotism. Greek history, after the expulsion of the Persians, is the history of the struggle between the higher and the lower patriotism, — between the two feelings known to the Greeks as Pan-Hellenism and Autonomism, represented respectively by Athens and by the Doric communities. The mournful history of Thukydides tells us how autonomism won the day, entailing the moral and political failure of Greek civilization.

But when Rome had extended her beneficent sway over all the precincts of the Mediterranean, uniting communities hitherto autonomous and hostile by common interests of culture and

of commerce, and bringing aggressive warfare to an end in the *Pax Romana*, then there became possible a cosmopolitan spirit, a Christian feeling, which regarded all men as legally and ethically equal, — equal before the Emperor, and equal before God. To trace the slow growth of this feeling in the annals of Roman law and of Stoic philosophy, and to observe its culmination in the genesis of Christianity,[1] is to obtain the key to Roman history.

But great political changes were necessary before Rome could carry to the end its great work, — partly because it had increased in size so much faster than it increased in structure. It crushed autonomism too rapidly. It developed imperialism at the expense of nationality. And hence the time at last arrived when the mutual cohesion of its provinces became too slight to withstand those barbaric assaults from without, which — as we should be careful to remember — had all along been intermittently attempted from the days of Brennus to those of Alaric. For a time, European society seemed likely to

[1] Of course it is not meant to imply that other elements were not at work in the genesis of Christianity. The growth of what Matthew Arnold calls the "spirit of Hebraism," not in Judæa merely, but throughout the Græco-Roman world, is an interesting phenomenon in this connection, but the treatment of it does not fall within the scope of the present exposition.

disintegrate into a set of tribal communities. But the old Empire had done its work too thoroughly for that. Roman principles, embodied in the Catholic Church, and in the renovated Empire of Charles the Great, exerted an organizing power which prevailed over the spirit of clannish isolation, and by effecting the grand series of compromises which we vaguely designate as the feudal system, laid the basis of modern society.

If now we examine the ethical circumstances of that vast modern fabric which has been reared upon material supplied in the older days of Rome — and which owes so much of its permanent character to the labours of the great Catholic and Imperial statesmen of the Middle Ages — we shall find that the process here described has been continually going on. For the primitive normal state of warfare there has been gradually substituted a normal state of peace. While in primitive times the interests of men were supposed to coincide only throughout the limited area of a petty clan, they are now seen to coincide throughout vast areas, and the railway, the steamship, and the telegraph are daily bringing communities into closer union, and, as George Eliot well expresses it, "making self-interest a duct for sympathy." The spirit of Christianity, first rendered possible by Roman cosmopolitanism, has made, and is ever making,

wider and deeper conquests as civilization advances. By the primitive savage moral duties were imperfectly recognized, but only within the limits of the clan. By the Greek the ethical code was enlarged, but it was a code not applicable to barbarians. The mediæval Christian had a still longer list of duties owed by him to all mankind, his brethren in the sight of God; and to the ancient conception of justice thus materially widened, he added, in elementary shape, the conception of benevolence or the "enthusiasm of humanity;" but the familiar maxim that "no faith need be kept with heretics" shows that even to his conception of duty there were practical limits narrower than would now be admitted. The modern, on the other hand, recognizes that he owes certain duties to all men with whom he may be brought into contact, not because they are his kindred, or his neighbours, or his countrymen, or his fellow Christians, but because they are his fellow men. Such is our ethical standard, however imperfectly conformed to; and neither ancient nor mediæval had such an ethical standard. Compare also the ideal types of perfect manhood at the two extremes of civilization within our ken. The primitive type is the man of intense personality, with an enormous sense of his own importance, easily roused to paroxysms of anger, brooking no contradiction, disregardful of the feelings of others,

domineering over all within his reach. The modern type is the man of mild personality, shunning the appearance of self-assertion, slow to anger, patient of contradiction, mindful of the feelings of those about him, unwilling to "make trouble." Such is the contrast between the typical ancient and the typical modern; and it implies a prodigious alteration in the dominant ethical feelings of the progressive portion of our race.

This change, as we now see, has been wrought by the slow but incessant modification of the social environment to which each generation of men has had to conform its actions. The altruistic feelings, finding at each successive epoch a wider scope for action, have become gradually strengthened by use; while the egoistic feelings, being less and less imperatively called into play, have become gradually weakened by disuse. And this change in the environment we perceive to have been wrought by the continuous growth of the community in size and complexity. Where, as among stationary tribes of savages, there has been no such growth, there the moral type of the primeval man is still to be found; and where, as among the stationary communities of Asia, there has been growth in size without corresponding growth in complexity, there the moral type is intermediate between that of the barbarian and that of the inheritor

of Roman civilization. Thus the progress of society is a mighty process of equilibration or adjustment, in the course of which men's rules of action and emotional incentives to action become ever more and more perfectly fitted to the requirements arising from the circumstance of their aggregation into communities.

Here we have arrived at a rudimentary conception of the law of social progress, so far as it can be obtained from a comprehensive historical induction, aided and verified by deduction from a few fundamental truths of biology. The foregoing discussion has brought out one point of fundamental importance, in which the development of social life agrees with the development of organic life: both are continuous processes of adjustment or equilibration. But in all this there is nothing more than might have been anticipated. Since the phenomena of society are really but the phenomena of life, specialized by the addition of new groups of circumstances, we must expect to find that the law of social evolution will be identical with the law of organic evolution, save only that it will require an all-important additional clause to express the results of the action of the superadded circumstances. Let us then seek to ascertain definitely, —*first*, in what respects the two kinds of evolution agree, and *secondly*, in what respects they differ.

In the first place the evolution of society, no less than the evolution of life, conforms to that universal law of evolution discovered by Mr. Spencer, and illustrated at length in earlier chapters. The brief survey just taken shows us that social progress consists primarily in the integration of small and simple communities into larger communities that are of higher and higher orders of composition; and in the more and more complete subordination of the psychical forces which tend to maintain isolation to the psychical forces which tend to maintain aggregation. In these respects the prime features of social progress are the prime features of evolution in general.

In the second place, the progress of society exhibits those secondary features of differentiation and integration which evolution universally exhibits. The advance from indefinite homogeneity to definite heterogeneity in structure and function is a leading characteristic of social progress. On considering primitive societies, we find them affected by no causes of heterogeneity except those resulting from the establishment of the various family relationships. As Sir Henry Maine has shown, in early times the family and not the individual was the social unit. In the absence of anything like national or even civic organization, each family chief was a monarch in miniature, uniting in his own

person the functions of king, priest, judge, and parliament; yet he was scarcely less a digger and hewer than his subject children, wives, and brethren. Commercially, it is needless to say, all primitive communities are homogenous. In any barbarous tribe the number of different employments is very limited, and such as there are may be undertaken indiscriminately by every one. Every man is his own butcher and baker, his own tailor and carpenter, his own smith, and his own weapon maker. Now the progress of such a society toward a civilized condition begins with the differentiation and integration of productive occupations. That each specialization of labour entails increased efficiency of production, which reacting brings out still greater specialization, is known to every tyro in political economy. Nor is it less obvious that, with the advance of civilization, labour has been steadily increasing in coherent heterogeneity, not only with regard to its division among different sets of mutually dependent labourers, but also with regard to its processes, and even its instruments. The distinguishing characteristic of modern machinery, as compared with the rude tools of the Middle Ages or the clumsy apparatus of the ancients, is its definite heterogeneity. The contrast between the steam-engine of to-day and the pulleys, screws, and levers of a thousand years ago assures us that the

Sir Henry Maine

growing complexity of the objects which labour aims at is paralleled by the growing complexity of the modes of attaining them. Turning to government, we see that by differentiation in the primeval community some families acquired supreme power, while others sank, though in different degrees, to the rank of subjects. The integration of allied families into tribes, and of adjacent tribes into nations, as well as that kind of integration exhibited at a later date in the closely knit diplomatic interrelations of different countries, are marked steps in social progress. Next may be mentioned the differentiation of the governing power into the civil and the ecclesiastical; while by the side of these ceremonial government grows up insensibly as a third power, regulating the minor details of social intercourse none the less potently because not embodied in statutes and edicts. Comparing the priests and augurs of antiquity with the dignitaries of the mediæval church, the much greater heterogeneity of the latter system becomes manifest. Civil government likewise has become differentiated into executive, legislative, and judicial. Executive government has been divided into many branches, and diversely in different nations. A comparison of the Athenian popular government with the representative systems of the present day shows that the legislative function has no more than any of

the others preserved its original homogeneity; while the contrast between the *Aula Regis* of the Norman kings and the courts of common law, equity, and admiralty, — county courts, queen's courts, state courts, and federal courts, — which are lineally descended from it, tells us the same story concerning the judicial power. Nor should it be forgotten that the steady expansion of legal systems, to meet the exigencies which civilization renders daily more complex, is an advance from relatively indefinite homogeneity to relatively definite heterogeneity.

Obviously, however, our task is not completed when we have pointed out this general coincidence between the development of society and the development of life. Nor can the universal law here illustrated be the special law of social progress for which we are seeking. By reason of its very comprehensiveness, the law of universal evolution cannot be regarded as supplying the precise kind of information we desire concerning the relations of social to organic phenomena. By its aid we have found it possible to interpret not only the development of life, intelligence, and society, but also the genesis of planetary systems and the evolution of the earth. It is therefore the law not only of social, psychical, and vital changes, but also of inorganic changes. Underlying all the sciences of genesis, and fusing them into one grand science of cosmogony, it

utters no truth concerning organic or social development which is not equally true of all development. Thus while it is indeed, in the deepest sense, the ultimate law to which organic and superorganic changes conform, it is silent respecting the differential characteristics by which these changes are distinguished from inorganic changes. Already in treating of the evolution of life we saw that the ultimate and general formula needed to be supplemented by a derivative and special formula, which should describe organic development in terms inapplicable to inorganic phenomena. And this formula we found in the definition of life as the continuous adjustment of inner to outer relations, upon which also was afterwards based our entire theory of the evolution of intelligence.

Now the historic survey into which we were led a moment ago, while inquiring into the progress of moral feelings, showed us that, in this respect also, the evolution of society agrees with the evolution of life in general. The progress of a community, as of an organism, is a process of *adaptation*, — a continuous establishment of inner relations in conformity to outer relations. If we contemplate material civilization under its widest aspect, we discover its legitimate aim to be the attainment and maintenance of an equilibrium between the wants of men and the outward means of satisfying

them. And while approaching this goal, society is ever acquiring in its economic structure both greater heterogeneity and greater specialization. It is not only that agriculture, manufactures, commerce, legislation, the acts of the ruler, the judge, and the physician, have since ancient times grown immeasurably multiform, both in their processes and in their appliances; but it is also that this specialization has resulted in the greatly increased ability of society to adapt itself to the emergencies by which it is ever beset. The history of scientific progress is in like manner the history of an advance from a less complete toward a more complete correspondence between the order of our conceptions and the order of phenomena. Truth — the end of all honest and successful research — is attained when subjective relations are adjusted to objective relations. And what is the consummation of moral progress but the thorough adaptation of the desires of each individual to the requirements arising from the coexistent desires of all neighbouring individuals? Thus the phenomena of social and of organic progress are seen to correspond to a degree not contemplated by those thinkers who, from Plato to Hobbes, have instituted a comparison between them. The dominant characteristics of all life are those in which social and individual life agree.

Let us now examine more closely the relations between the Community and the Environment. From the twofold circumstance that life is high according as the organism is heterogeneous, and also according as it is adjusted to surrounding conditions, may be derived the corollary that *the heterogeneity of the environment is the chief proximate determining cause of social progress.* Thus we may understand why civilization advances so much more rapidly in modern than it did in ancient times.[1] As Sir Charles Lyell observes: "We see in our own times that the rate of progress in the arts and sciences proceeds in a geometrical ratio as knowledge increases, and so, when we carry back our retrospect into the past, we must be prepared to find the signs of retardation augmenting in a like geometrical ratio; so that the progress of a thousand years at a remote period may correspond to that of a century in modern times, and in ages still more remote Man would more and more resemble the brutes in that attribute which causes one generation exactly to imitate in all its ways the generation which preceded it."[2] That the process is here the same in social and in organic life, Sir Charles Lyell already suspects; for he elsewhere observes that the lower the place of organic beings "in a graduated scale, or the simpler their structure, the more persistent are they in

[1] See above, p. 72. [2] *Antiquity of Man*, p. 377.

form and organization. In whatever manner the changes have been brought about, the rate of change is greater where the grade of organization is higher." And this fact results from the more complex relations of the higher beings to their environment. Applying these considerations to history, it will be seen that, owing to the political isolation of ancient communities, the heterogeneity of their environments must have been inconsiderable. Holding little intercourse with each other, and accommodating their deeds and opinions mostly to the conditions existing at home, their progress was usually feeble and halting. Owing to the enormous heterogeneity of the environment to which modern communities are forced to adjust themselves, progress in later ages has been far more rapid and far more stable than of old. The physical well-being of an ancient Greek was not enhanced by an invention made in China, nor could his philosophy derive useful hints from theories propounded in India. But in these days scarcely anything can happen in one part of our planet which does not speedily affect every other part. The physical environment of a modern European extends over a great part of the earth's surface, and his psychical environment is scarcely limited in time or space. His welfare is not unfrequently affected by accidents occurring at the antipodes, while his plans for the coming year are often shaped

with conscious or unconscious reference to events which happened centuries ago. That the rapid and permanent character of modern progress is in great measure due to this circumstance will be denied by no one. And thus is explained the wonderful civilizing effect of various events which have from time to time brought together distant sections of mankind; among which it will be sufficient merely to name the campaigns of Alexander, the spread of Roman dominion, the Arabian conquests, the Crusades, and the voyages of Columbus, Magellan, and De Gama. The invention of printing, increasing the rapidity and the frequency with which the thoughts of various minds are brought into contact, offers another illustration; and in a similar way is to be explained the civilizing agency of railroads and telegraphs.

Comparing these deductions with the historical survey of ethical development above taken, we arrive at a set of mutually harmonious conclusions. We see that the process of intellectual and moral adaptation which constitutes social progress is determined by the steadily increasing heterogeneity of the social environment. And we see that this increased heterogeneity of the environment is caused by the integration or growing interdependence of communities that were originally isolated. We have now to examine this process of integration somewhat

more in detail. By instituting a novel comparison between the processes of organic and of social life, we shall be led directly to the special law of progress for which we are seeking.

Observe first that the living beings which are lowest, or next to the lowest, in the scale of organization — as, for example, the protococcus and the amœba — are nothing but simple cells. It has been shown, by Mr. Spencer, that progress in morphological composition, both in the animal and in the vegetable kingdoms, consists primarily in the union of these simple cells into aggregates of higher and higher orders of complexity. Now in the study of social evolution we are met by precisely similar phenomena. Let us consider what is implied by the conclusions at which Sir Henry Maine has arrived, in his profound treatise on "Ancient Law," by an elaborate inquiry into early ideas of property, contract, and testamentary succession, and into primitive criminal legislation. "Society in ancient times," says Sir Henry Maine, "was not what it is assumed to be at present, a collection of *individuals*.[1] In fact, and in the view of the men who composed it, it was an aggregation of

[1] [In chapter ix. of Part III. of his *Principles of Sociology*, Spencer criticises the theory of Maine at length, and undertakes to show its limitations. Fiske would probably have been led to modifications of his views had this chapter been before him.]

families. The contrast may be most forcibly expressed by saying that the *unit* of an ancient society was the *family*, of a modern society the *individual*."[1] But originally the family government excluded not only individual independence, but also state supremacy. The sole government actual or possible was that exercised by the male head of a family group. By slow stages various family groups closely akin in blood appear to have become integrated into tribes or clans, community of descent being still the only conceivable bond which could hold together a number of individuals in the same political aggregate. At a later stage the limits of the tribe were further enlarged by the important legal fiction of "adoption," or the pretence that newly added members were descended from some conspicuous common ancestor of the tribe. Vestiges of a time when there were no aggregations of men more extensive than the tribal community thus constituted, and when there was no sovereign authority save that exercised by the head of the tribe, may be found in every part of the world,[2] and among totally savage races this state

[1] *Ancient Law*, p. 126.

[2] "The γένος of Athens, the *gens* of Rome, the *mark* or *gemeinde* of the Teutonic nations, the village community of the East . . . the Irish clan, are all essentially the same thing." Freeman, *Comparative Politics*, p. 102.

See, among other authorities, Volney's *View of the United*

of things still continues. Now we shall find something more than an instructive analogy in the comparison of the primitive family group to a unicellular organism, for such a comparison will enable us to realize that in social and in organic evolution the process of integration has been substantially the same. The first well-marked stage in coalescence is the formation of the tribe or clan, which may be compared to those lowly organisms made up by the union of amœba-like units with but little specialization of structure or function. At this stage social organization is but one step removed from that absolute and ferocious anarchy which characterizes the non-social life of brutes. "Mistrust, jealousy, secret ambushes, and implacable vengeances" characterize the mutual relations of these social "aggregates of the first order." Hostility is the rule, and peace the exception. The repulsive forces are stronger and the cohesive forces weaker than at any subsequent period. As we have seen above, the selfish impulses which tend to maintain savage isolation are as

States, p. 397 ; Phillipp on *Jurisprudence*, p. 207 ; Charles Comte, *Traité de Législation*, liv. iii. chap. 28 ; Grote, *History of Greece*, vol. iii. pp. 49–69 ; Gibbon (Paris edition), vol. iii. p. 243 ; Vico, *Scienza Nuova*, *Opere*, tom. iv. pp. 23, 35, 40 ; Aristotle, *Eth. Nikom.* viii. 14 ; Tacitus, *Germania*, vii.; Cæsar, *Bell. Gall.* vi. 22, 23.

yet unchecked save by instinctive loyalty within the tribal limits.

The coalescence of such tribes into civic communities is the formation of social "aggregates of the second order." For a long time these higher aggregates retain conspicuous traces of their mode of composition, as in Greece and Rome,[1] until increasing social heterogeneity obliterates the original lines of demarcation; while new divisions spring up, resulting from the integration of like parts, as is seen in the guilds of mediæval Europe, and still better in the localization of industries which marks the present time.

The coalescence of civic and tribal communities into the nation — an "aggregate of the third order" — is well exemplified in the history of France, which, from a disorderly collection of independent baronies, has passed by well-defined transitions into a perfectly integral nation. The attainment of this stage is indispensable to a career of permanent progress. As hinted above, the premature overthrow of the

[1] The structure of the Amphiktyonic union shows "that the system of cities with which we are so familiar in Grecian history grew out of an earlier system of tribes." Freeman, *Comparative Politics*, p. 88. Further evidence, in abundance, may be found in the succeeding pages of that excellent book, which reads, from beginning to end, almost like a commentary upon this chapter.

Hellenic political system is to be attributed to its very incomplete integration. An aggregate of the national type was in process of formation by the extensive coalescence of maritime cities under the leadership of Athens, when the Peloponnesian war intervened, vindicating the superiority of selfish autonomy, and showing by its result that the civilizing spirit of nationality was as yet too feeble to prevail.

It was first under Roman dominion that national aggregation and the feeling of national solidarity began to be brought to something like completeness. By absorbing nearly all the petty communities then existing within the limits of the Mediterranean world, and by gradually extending to their members the privileges of citizenship, Rome succeeded in dealing to the passion for autonomy a blow from which it has never recovered; while the enormous extent of the Empire, and its ethnic heterogeneity, imparted to the national spirit thus evoked a cosmopolitan character destined to be of prodigious service to civilization. The influence of these circumstances upon the attitude of Christianity I have already alluded to, and it cannot be too strongly insisted upon. No human mind could have even conceived, much less have carried into execution, the idea of a universal religion, if the antique state of social isolation had not previously been brought to a close in universal

empire. If Christianity had appeared four centuries earlier than it did, it would, like Buddhism, have assumed the garb of a local religious reformation. Or if it could have aimed at anything higher and more comprehensive than this, its preaching would have fallen upon ears not ready to receive it. All the Oriental enthusiasm, all the Hellenic subtlety of Paul could have effected nothing, had he visited Athens in the days of Plato and Diogenes. But the cosmopolitan element in Roman civilization was just that which Christianity most readily assimilated, and which it intensified by setting up a new principle of common action in place of the primeval principle of community of race. From this happy concurrence of circumstances there was formed, upon the ruins of Paganism, that religious organization which alone, of all churches that have existed, has earned the glorious name of Catholic. Disgusted at some of her high-handed proceedings in later times, Protestant historians have too generally forgotten that the Roman Church, by coördinating the most vigorous and progressive elements of ancient life, prepared the way both for the ubiquity and for the permanence of modern civilization. Had the ecclesiastical system of the Empire perished, along with the breaking up of its political system; had there been really that wreck of ancient institutions in the fifth century which was

formerly supposed to have occurred, until Mr. Bryce and Mr. Freeman dispelled the gross error; it is difficult to see how mediæval European history could have been politically anything more than a repetition of Grecian history, save only in the extent of its geographical range. Whoever is disposed to doubt so emphatic an assertion will do well duly to ponder the fact that the newly arriving Teutonic subjects of the Empire (who would, in such case, have come as foreign conquerors) had not advanced beyond the stage of tribal organization. On their further aggregation into rural and civic bodies, the autonomous spirit would have acquired an ascendency which it might well have taken another more fortunate Athenian federation, or another all-absorbing Roman domination, thoroughly to destroy. Even as it was, it required all the immense power of the Church, unflinchingly exercised through many generations, to prevent European society from disintegrating into a mere collection of mutually repelling tribal communities. But the Church not only preserved the best social results of Roman dominion, by hastening the consolidation of each embryonic nationality; it also, by its peculiar position as common arbiter between the different states thus arising, assisted in the formation of a new social aggregate of a yet higher order. The modern system of independent nationali-

ties held in virtual federation — not by international codes, but by the possession of guiding principles of conduct more or less heartily reverenced by all — is chiefly the work of the Roman Church. Here, finally, we have reached a system whose structure bears in the highest degree the marks of permanence. It is sustained by the ever-deepening sentiments of cosmopolitan philanthropy and universal justice, — the most cohesive of social forces, as the spirit of local selfishness was the most disruptive.

Here it might seem that we have obtained all the data requisite for enunciating our law of social progress. But something is still wanting. Our law of progress, if now enunciated, would be too general. It would cover alike the phenomena of social and of organic life. In both there is an advance from indeterminate uniformity to determinate multiformity; in both there is a continuous adaptation of the organism or the community to its environment; and in both there is a continuous integration, entailing an advance from incoherence to coherence of structure. We must now start in search of that all-important clause which shall express the essential difference between organic and social progress.

In the ancient family community, as delineated by Sir Henry Maine, the separate existence of the individuals was almost submerged

and lost in the corporate existence of the aggregate. Personal freedom was entirely unrecognized. To family duties all individual rights were subjected. By a tie, religious no less than political, the members of the family were all held in allegiance to its oldest male representative. The father might abandon his son in infancy, and when grown up might sell him as a slave, or put him to death for disobedience. And the wife was to an equal extent in the power of her husband, to whom she legally stood in the relation of a daughter, so that marriage was but the exchange of one form of servitude for another. No transfer of property was valid, unless the persons conducting it swore in the name of some ancestor, — dead ages ago, it might be; for so absolute was the authority of the *paterfamilias* that it could not be conceived as departing from him at death, but must be exercised by him, through the medium of prescriptive ceremonial, over whole generations to come. Nothing, in short, was regulated by *contract*, but everything was determined by *status*.[1] And this is the fact which irretrievably demolishes Rousseau's theory that social aggregation is due to a primitive compact. That

[1] This term is well defined by Heineccius: "Status est qualitas cujus ratione homines diverso jure utuntur. . . . Alio jure utitur liber homo; alio servus; alio civis; alio peregrinus." *Recitationes*, lib. i. tit. 3.

theory is merely an illegitimate attempt to explain an ancient phenomenon by causes which have had only a modern existence.[1] The member of a primitive tribal community had no conception of contract; what he was born to do belonged to his status; and that he must do. The prevalence of this state of things in the empires of the East is chief among many converging proofs that those nations are nothing but immense tribes, or aggregates of the first order.

With the rise of higher aggregates, such as states, civic or imperial, this sinking of the individual in the corporate existence still for some time continued. The rights and duties of the individual were still unrecognized, save in so far as they followed from the status in which he happened to be placed. In republican Rome, and in the Hellenic communities, the welfare of the citizen was universally postponed to the welfare of the state. But circumstances too complicated to be here detailed, of which the chief symptom was the increasing importance assigned by Roman jurisprudence to contracts, resulted, at an advanced period of the empire, in the more or less complete recognition of in-

1 See the discussion of the doctrine in Austin, *Province of Jurisprudence*, pp. 331–371; Kant, *Rechtslehre*, Th. ii. Abschn. i.; Stahl, *Philosophie des Rechts*, ii. 142; Maine, *Ancient Law*, chap. iv.

dividual rights and obligations. On the rise of the feudal system, the relations of vassal to suzerain were, through the influence of Roman conceptions, extensively regulated by contract; and it is in this respect that the feudal institutions are most widely distinguished "from the unadulterated usages of primitive races." [1] It was, I believe, mainly owing to this that the integration of feudal lordships into nations was accompanied by the enlargement of individual liberty to a much greater extent than the integration of ancient clans, gentes, and phratries into civic communities. The Roman Church also aided in promoting the freedom of individuals, as well as in facilitating the consolidation of states. By the more or less strict enforcement of clerical celibacy, it maintained in the midst of hereditary aristocracy a comparatively democratic organization, where advancement largely depended upon moral excellence or intellectual ability. And preserving, by the same admirable institution, its independence of feudal patronage, it was often enabled successfully to interpose between the tyranny of kings and the helplessness of subjects. To ecclesiastical celibacy, more than to almost any other assignable institution, we owe our emancipation from ancient patriarchal conceptions of social duty. The development of industry, crossing in various

[1] Maine, op. cit. p. 365.

ways the antique divisions of society, has contributed to the same result; until, in modern times, the primitive mode of organization is almost entirely effaced, leaving but few barely traceable vestiges. Individual rights and obligations, from being nothing, have come to be all in all. While originally the individual was thought to exist only for the sake of the state, the state is now regarded as existing only for the sake of the individual.

It will thus be seen that the very same process, which has resulted in the formation of social aggregates of a higher and higher order, has also resulted in the more and more complete subordination of the requirements of the aggregate to the requirements of the individual. And be it further noticed, that the relative strength of the altruistic feelings, which maintain the stability of the highest social aggregation, maintains also to the fullest extent the independence of its individual members; while the relative strength of the egoistic feelings, which in early times prevented the existence of any higher organization than the family or tribe, was also incompatible with individual freedom of action. Now this is precisely the reverse of the state of things which we find in organic evolution. In organic development, the individual life of the parts is more and more submerged in the corporate life of the whole. In

social development, corporate life is more and more subordinated to individual life. The highest organic life is that in which the units have the least possible freedom. The highest social life is that in which the units have the greatest possible freedom. This feature of social evolution is most conveniently described by Schelling's term *individuation*, which is employed in a kindred sense both in Mr. Spencer's and in other modern works on biology.

Thus we have at last reached the conclusion in quest of which we set out. Supplementing our previous results, according to which organic and social evolution were seen to agree, by our present result, according to which they are seen to differ, we obtain a formula for social evolution which may be regarded as fundamentally accurate. We obtain the Law of Progress, which may be provisionally stated as follows: —

"*The Evolution of Society is a continuous establishment of psychical relations within the Community, in conformity to physical and psychical relations arising in the Environment; during which, both the Community and the Environment pass from a state of relatively indefinite, incoherent homogeneity to a state of relatively definite, coherent heterogeneity; and during which, the constituent Units of the Community become ever more distinctly individuated.*"

In the next chapter I shall proceed to show

how this exceedingly general and technical formula includes and justifies whatever is defensible in sundry less abstract generalizations, expressed in more popular language, by Comte and Buckle. We shall be called upon to pass in review certain phases of social evolution, and to criticise, with the aid of the theorems now at our disposal, the claims of Comte to be regarded as the founder of sociology.

CHAPTER XIX

ILLUSTRATIONS AND CRITICISMS[1]

THE discussion contained in the foregoing chapter has shown to what a notable extent the phenomena of social evolution may be expressed, with the strictest accuracy, by formulas originally invented to describe the evolution of life in general. Let us briefly review the results which we have already obtained.

First, we saw that social as well as organic evolution consists in the continuous adaptation of the community, or organism, to the environment. Or, expressing the same thing in other words, social progress is a continuous establishment of inner relations in conformity to outer relations.

Secondly, we saw that in the course of this adaptation the community, like the organism, continually increases in definite heterogeneity, through successive differentiations and integrations.

Thirdly, we saw that in the community, as in the organism, the increase in internal heteroge-

[1] [See Introduction, § 24.]

neity is determined by the continuous increase of heterogeneity in the environment.

Fourthly, we saw that the increase of heterogeneity in the environment is determined by the successive integration of communities into more and more complex and coherent aggregates. And this law also holds of organic progress.

These four generalizations, expressing the points in which social and organic development coincide, were summed up in the first two clauses of our law of progress. They are immediate corollaries of the law of universal evolution and of the definition of life as adjustment. They are not to be understood as mere expressions of striking analogies. They are to be understood as implying that the evolution of life and the evolution of society are, to a certain extent and in the most abstract sense, identical processes. Such a conclusion, indeed, became inevitable the moment we were brought to admit that the phenomena of society constitute but a specialized division of the phenomena of psychical life.

Nevertheless it would be a grave error to infer, from this necessary coincidence in development, that a community is nothing more than a kind of organism, as Plato imagined in his "Republic," and Hobbes in his "Leviathan." When we go so far as to compare the metropolis of a community to the heart of an organism, its roads to blood vessels, its circulating

commodities to circulating nutritive materials, its money to blood corpuscles, its channels for transmitting intelligence to nerve axes, and the individuals of which it is composed to physiologic units; we are instituting a series of analogies, which are no doubt of considerable value in the study both of history and of political economy. In his essay on the "Social Organism," Mr. Spencer has traced a great number of such analogies, which are no less instructive than curious, but they are after all analogies and not homologies. So when M. Littré points out that the study of political economy stands in the same relation to the science of sociology as the study of the nutritive functions to the science of biology, he reveals an analogy of great philosophical value. But we nevertheless feel that there is a wide distinction between an organism and a community, which it would be absurd to ignore; and Hobbes's conception of society as a vast Leviathan strikes us as grotesque.

This insuperable distinction is the fact that in a community the psychical life is all in the parts, while in an organism the psychical life is all in the whole. The living units of society "do not and cannot lose individual consciousness," while "the community as a whole has no corporate consciousness." "The corporate life must here be subservient to the lives of the parts, instead of the lives of the parts being

subservient to the corporate life."[1] The historical induction at the close of the preceding chapter showed us that such has been the case. While during the advance toward greater heterogeneity and coherence, the original lines of demarcation between communities have been ever becoming effaced as the communities have become integrated into higher and higher aggregates, we saw that as a part of the very same process the individualities of the members of society have been ever increasing in definiteness and ever acquiring a wider scope for activity. And we saw that this process not only has ever gone on, but must continue to go on; since, by the law of use and disuse, the sympathetic or social feelings must continue to grow at the expense of the selfish or anti-social feelings; and since this slow emotional modification, which makes possible the higher integration of society, ensures also the higher individuation of its members. "Progress, therefore, is not an accident, but a necessity. Instead of civilization being artificial, it is a part of nature; all of a piece with the development of the embryo or the unfolding of a flower. The modifications mankind have undergone, and are still undergoing, result from a law underlying the whole organic creation; and provided the human race con-

[1] Spencer's *Essays*, 2d series, p. 154. [Library Edition, vol. i. pp. 176, 177.]

tinues, and the constitution of things remains the same, those modifications must end in completeness."[1] As surely as the astronomer can predict the future state of the heavens, the sociologist can foresee that the process of adaptation must go on until in a remote future it comes to an end in proximate equilibrium. The increasing interdependence of human interests must eventually go far to realize the dream of the philosophic poet — of a Parliament of Man, a Federation of the World,

"When the kindly earth shall slumber, lapt in universal law,"

and when the desires of each individual shall be in proximate equilibrium with the means of satisfying them and with the simultaneous desires of all surrounding individuals. Such a state implies at once the highest possible individuation and the highest possible integration among the units of the community; and it is the ideal goal of intellectual and moral progress.

Thus the fundamental law of progress, as formulated at the close of the last chapter, contains all the provisions requisite in such a formula. It describes, in a single grand generalization, all the phenomena of social evolution, both in so far as they result from the general laws of life, and in so far as they result from the operation of circumstances peculiar to the aggregation of

[1] Spencer, *Social Statics*, p. 65.

intelligent organisms in a community. And it includes and justifies all the minor generalizations which may be reached by a direct induction from historical phenomena solely.

This law of progress we find to be exceedingly abstract — it expresses a general truth quite completely disengaged from the incidents of particular cases. Such, as we were led to anticipate, must be the character of a law which generalizes a vast number of complex phenomena. A formula which is to include in one expression phenomena so different as the rise of Christianity and the invention of the steam-engine must needs be eminently abstract. To attempt to make it concrete, so as to appeal directly to the historical imagination, would be to deprive it of its universality, to increase its power of expressing some one set of phenomena by rendering it powerless to express some other equally important set. This consideration explains the manifest failure of all the attempts which have been made to determine the general law of progress by a simple historical induction. Take, for example, the two crude generalizations which pretty nearly sum up the philosophy of history as it is contained in the work of Mr. Buckle, — that "scepticism" is uniformly favourable to progress, while the "protective spirit" (or, the spirit of over-legislation) is uniformly detrimental to it. These, in the first

place, are generalizations drawn from a peculiar and temporary phase of society and illegitimately extended to all phases of society; and, in the second place, even so far as they go, they have but a limited applicability — expressing at best certain aspects of intellectual and industrial progress, but leaving quite out of sight that slow moral evolution which underlies the whole. Whatever of truth is contained in these statements is also contained in the formula which I am here expounding, and is much more accurately expressed in the terms of that formula. Scepticism, for instance, in the best sense of the word, is the attitude of mind which is caused by the perception that certain inner psychical relations — say, a given set of beliefs or institutions — have ceased to be adapted to outer relations. The mediæval conception of the world, as presented in Dante's treatise on "The Monarchy," was very closely adapted both to the knowledge and to the social needs of the time. The conception of man as the centre of a universe made solely for his use and behoof, with a sun to give him light by day and a moon and stars to give him light by night, with an Emperor and a Pope divinely appointed to rule him in this life, and an Autocrat in heaven uniting in himself the functions of these two, and ruling nature according to his arbitrary will; this conception, I say, was in harmony both with the best science and

with the most urgent social requirements of the time, and the fact of its long duration shows how profound was the harmony. While this state of things lasted, there was but little room for scepticism. But after a while the psychical environment had so far altered as to be out of balance with this conception of the world. The Copernican revolution unseated Man from his throne in the centre of the universe, and advancing physical generalization cast discredit upon the theory of providential government, and so arose the long line of "infidels" from Bruno and Vanini to Voltaire and Diderot. While, on the other hand, the increasing power of monarchy, especially in France, gradually undermined the moral independence of the Papacy, converting it from an upholder of equity and a friend of the people into an unscrupulous ally of regal usurpation and iniquity; and thus arose the Great Schism, followed by the Protestant revolt, and the grand democratic movement which culminated in the French Revolution. Now what is all this infidel rebellion against dogma and democratic rebellion against authority but the intellectual and moral turbulence caused by the growing conviction that the psychical relations comprised in the authorized conception of the world were out of balance with the new aggregate of relations formed by the discoveries of science and the altered require-

ments of social existence? And this painful attitude of the mind, prompting men to fresh investigation of the order of nature and to new social rearrangements, is the stimulus to a new and closer adaptation.

Such is the function of scepticism in the community, and such also is its function in the individual. A person, for instance, is educated in an environment of Presbyterian theology, accepting without question all the doctrines of Calvinism. By and by his environment enlarges. Facts in science or in history, methods of induction, canons of criticism present themselves to his mind as things irreconcilable with his old creed. Hence painful doubt, entailing efforts to escape by modifying the creed to suit new mental exigencies. Hence eager study and further enlargement of the environment, causing fresh disturbance of equilibrium and renewed doubt resulting in further adaptation. And so the process continues — until, if the person in question be sufficiently earnest and sufficiently fortunate, the environment enlarges so far as to comprehend the most advanced science of the day; and the process of adaptation goes on until an approximate equilibrium is attained between the order of conceptions and the order of phenomena, — and scepticism, having discharged its function, exists no longer, save in so far as it may be said to survive in the in-

grained habit of weighing evidence and testing one's hypotheses.

Now to say that scepticism is one of the causes of progress is to make a historical induction which is valuable as far as it goes; but it is at best an empirical generalization. To make it a scientific law, we need to express the function of scepticism in terms of some formula which covers all the phenomena of progress. And who does not see that in so expressing it we are obtaining a far more definite and accurate and serviceable notion than when we merely state vaguely that scepticism is a cause of progress?

Just so with the statement that the protective spirit is a hindrance to progress. By the colloquial phrase "protective spirit," Mr. Buckle means the control, or at least the undue control, of the community over its individual members. Now in estimating the effect of this circumstance upon progress, everything depends upon the precise amount of such control which we are to regard as excessive. But this varies with each epoch of civilization. What would now be intolerable despotism was once needful restraint. You cannot have a constitutional democracy of Vandals or Moguls. So long as men's altruistic feelings are not powerful enough to make them spontaneously respect the claims of their fellows, the only force which can make

society hold together is that hero worship which enjoins implicit obedience to the head of the tribe or state. But as we have already seen, the steady growth of altruism at the expense of egoism, which renders possible a more complete social aggregation, renders possible also a more complete development of individual liberty. So that what in one age is a needful control exercised by the community over its members becomes in the next age an undue control. All this is expressed in the law of progress, as here formulated; but it is not expressed, with any approach to accuracy, in the crude statement that the protective spirit is an obstacle to civilization.

Indeed the longer we study this general formula, the more we shall be convinced that it includes and justifies all sound inductions which can be derived from a survey of historical phenomena. As we apply it to the facts of history one after another, we shall see more clearly that its very abstractness is its excellence, and that the initial difficulty in thoroughly realizing its import arises from its very fulness of meaning. And we shall become ever more deeply impressed with the belief that no amount of mere historic induction can give us a universally applicable law of social progress, unless our results be deductively interpreted as corollaries from the general laws of life.

We are now in a position to examine the claims of Comte to be regarded as the founder of sociology. And first let us note that a law of social progress answering so many requirements as are met by the law above expounded could not have been obtained earlier than the present generation or even than the present decade.

To conceive of sociogeny as a specialized branch of psychogeny, itself a specialized branch of biogeny, was not possible until a general science of genesis had been at least partially instituted. The very idea of a science of genesis as applied to organic phenomena was not elaborated until the appearance of Von Baer's great treatise in 1829. And the conception was then altogether too novel to be worked into the web of philosophy which Comte was weaving. Considering how, throughout the latter part of his life, he steadfastly refrained from the study of contemporary scientific literature, I do not think it likely that Comte ever became aware of the growing prominence of this conception of genesis; and if he had become aware of it he would doubtless have scornfully repudiated it, as he repudiated almost every new conception which was distinctly in advance of the limited scientific knowledge of 1830. The knowledge which Comte was not prepared to utilize at that date, he was certainly not in a condition to util-

ize at any later period of his life. It was in 1857, the year of Comte's death, that Mr. Spencer, in an essay entitled "Progress: its Law and Cause," first definitely extended the law of organic development to historic phenomena; although he had ever since 1851 been visibly working toward that result, and had in 1855 reached that grand generalization of the development of both life and intelligence, regarded as processes of adjustment, which underlies the law of social progress here expounded. It was this splendid series of researches, culminating in the announcement of the universal law of evolution, in 1861, which supplied a new basis for all the sciences which treat of genesis, and rendered possible the discovery of the special laws of sociogeny. And finally, in 1861, the further clew to these special laws was given by Sir Henry Maine, whose immortal treatise on "Ancient Law" threw an entirely new light upon the primitive structure of society, and demonstrated — what before could only have been surmised — that human society, as earliest organized, consisted of a congeries of tribal communities, by the integration of which have arisen the various orders of states and federations known to history.

When, therefore, we inquire whether Comte did or did not create a science of sociology, we need not be surprised if it appears that he did

not create such a science. For in sociology, even more than in any other science, the prime requisite is to formulate the law of evolution — in this case, the order of sequence of historic events from epoch to epoch. So far as a science of society could be founded upon purely statical considerations, the work had already been performed — by Adam Smith, as regards political economy, by Bentham, as regards jurisprudence, and by both these great thinkers, as regards ethics. But ethics, jurisprudence, and political economy, put together, do not make up a science of society, as Comte clearly saw. For in sociology the historical element — the question whence we started and whither we are bound — is the element which takes precedence of all others. Even ethics, jurisprudence, and political economy cannot be placed upon a truly rational basis until we understand the order of intellectual and moral change from epoch to epoch. To understand the " tendencies of the age " is an indispensable prerequisite for sound sociological thinking as well as for sound political acting. Thus that portion of sociology which treats of genesis is, relatively to the whole science, even more important than the corresponding portions of biology and psychology. In biology pure and simple, we can, as we have seen, obtain a tolerably complete notion of the order of changes in the organism, with but occasional

reference to the comparatively stable and unchanging environment. In psychology we have to take the environment into account at every step; but unless we are studying the quite special problem of the growth of the mental faculties, we do not need to refer to a definite and persistent succession of changes in the environment. But in sociology we cannot work in this way. As M. Littré has well pointed out, when we come to study humanity we are met by a new phenomenon unknown in biology or in psychology pure and simple. That new phenomenon is Tradition, or the bequeathing of all its organized intellectual and moral experience by each generation to its successor. Here for the first time we have an environment which is rapidly changing in a definite order of sequence, and changing by the very activity of the community itself. The organized experience of each generation becomes a part of the environment of its successor, and since in each successive age "the empire of the dead over the living increases," the environment of each generation consists to a greater and greater extent of the sum total of traditions bequeathed by all past generations. Hence we cannot hope scientifically to comprehend the simplest feature in any given state of the community without reference to ancestral states. The religious phenomena of the present day, for example, cannot

be understood without previous knowledge of the whole history of Christianity, and indeed of human speculative thought since men began to be aware of the universe about them. Our political organization can be scientifically interpreted only as the offspring of ancestral political organizations in a series reaching back to the primitive tribal community.[1] And so with all the aspects of society. Whether we are studying a creed, a code of laws, a dialect, a system of philosophy, a congeries of myths, or a set of manners and customs, we can arrive at the rational solution of our problem only through a historical inquiry. Hence the doctrine of genesis, indispensable as it is in the other two organic sciences, becomes, if one may say so, even more indispensable in sociology. Here the whole science rests upon sociogeny, and until we have reached a scientific conception of progress we cannot stir a step.

Thus, in addition to the unparalleled complexity of its phenomena, and to its general dependence both for doctrine and for method upon the simpler sciences, we perceive still another reason why the science of sociology has been the last to be constituted. Resting as it does upon the law of progress, it has had to

[1] See Mr. Freeman's book, *Comparative Politics*, — the work of a great scholar who inherits the gift of Midas, and makes gold of every subject that he touches.

wait not only until the preceding sciences were founded, but until they were sufficiently advanced to supply it with the general formula of organic development, from which alone the law of social progress could be deduced. It was not enough that Bichat had laid the foundations for a general theory of nutrition, reproduction, and innervation, or that James Mill had established the fundamental laws of association — though this was indeed much. The new science had to wait until Von Baer had traced the order in which organisms develop, until Mr. Darwin had shown how through heredity and natural selection organisms become adapted to their environments, and until Mr. Spencer had shown how associated ideas and emotions are slowly generated and modified in conformity to surrounding circumstances.

All this, of course, could not be foreseen by Comte. But he nevertheless clearly saw — and it does honour to his philosophic acumen — that a comprehensive theory of social changes can be obtained only by studying them in the order of their historical dependence. He saw that the laws of sociology are at bottom the laws of history. And especially, from the practical point of view, he saw that no general theory fit to serve as a basis for the amelioration of society could be deduced from mere abstract reasonings about human nature, or obtained in-

ductively from the mere observation of contemporary social phenomena. All theories formed in this way, without reference to the order of historic progression, are in danger of being stated too absolutely, and are wont to give birth only to utopian projects. Comte was never weary of pointing out the errors of those political economists who deduce general laws of accumulation and distribution from the industrial phenomena presented by a single country at a particular epoch; or of those moralists who base their theories upon that absurdest of aphorisms, that "human nature is always and everywhere the same;" or of those legislators who, in ignorance of the fact that humanity is travelling in a definite and partially ascertainable direction, fondly hope to turn it hither and thither by shrewdly concocted acts of parliament. Nor, in maintaining this last position, did he ever fall into the opposite error, — characteristic of superficial writers like Macaulay and Buckle, — that individual genius and exertion is of little or no account in modifying the course of history. He did not forget that history is made by individual men, as much as a coral reef is made by individual polyps. Each contributes his infinitesimal share of effort; nor is the share of effort always so trifling. Considering the course of history merely as the resultant of the play of moral forces, is there not in a Julius Cæsar or

a Themistokles as large a manifestation of the forces which go to make history as in thousands of common men? Nevertheless the fact remains that civilization runs in a definite path, that the sum total of ideas and feelings dominant in the next generation will be the offspring of the sum total of ideas and feelings dominant in this, and that only by understanding the general course of the *movement* of humanity can we hope to make our volitions count for much as an item in the resulting aggregate of effects.

Holding such views as these, Comte saw that the first aim of the sociological inquirer must be to ascertain the law of progress. And accordingly he set himself to work to perform this task, with the only instrument then at his command, — that of historical induction. I have already remarked upon his wonderful skill in the use of that instrument of research. I doubt if any one has ever lived who had a keener sense of the significance of historic events, so far as such significance could be perceived without the aid of conceptions furnished by the sciences of organic development. The fifth volume of the "Philosophie Positive" is certainly a marvellous tableau of the progress of society. I know of no concrete presentation of universal history which can be compared with it. The general excellence of the conception is matched by the excellence of the execution even to the smallest

details. And amid the host of pregnant suggestions concerning Greek and Roman, and especially concerning mediæval history, the great fact that there has been and is a determinate order of sequence in human affairs is placed quite beyond cavil on the highest plane of inductive demonstration.

To achieve so much as this was to show that a science of sociology is possible, and to prepare the way very thoroughly for the creation of such a science. But Comte professed to have done more than this. He regarded himself as the founder of sociology, and is so regarded by his disciples. It is part of our business to determine, if we can, whether the claim is a valid one; and in order to do this, we must examine the theorems which Comte propounded as the fundamental laws of progress.

These theorems are two in number, — the first relating to the intellectual, the second to what we may call the material, development of mankind. The first is an old acquaintance, being nothing else than the generalization that all human conceptions must pass through three stages — the theological, the metaphysical, and the positive. We have already (Part I., chapter vii.) examined this theory upon its own merits. Tried by a psychological analysis, we have found it to be only partially true. We saw it to be correct in so far as it asserts that the prevailing

conception of the world becomes less and less anthropomorphic from age to age; but incorrect in so far that it asserts that in this deanthropomorphizing process there are three radically distinguishable stages, and also, in so far as it asserts that the process must end in Positivism. We saw that, although without doubt men began by seeing volition everywhere and must end by seeing an inscrutable Power everywhere, nevertheless the mental process has throughout been one and the same, and any appearance of definite stages can be only superficial. Nevertheless, between the primeval savage who prays to his fetish and the modern philosopher who recognizes that he must shape his conduct according to invariable laws or pay the penalty in some form of inevitable suffering, the difference in mental attitude is so vast that we may well have a distinction in terms to correspond to it. It is for this reason that I have frequently contrasted Anthropomorphism and Cosmism as the initial and final terms of a continuous progression. This, however, is not the Comtean doctrine. Again, metaphysics, as Comte understands it, being merely imperfect scientific inquiry conducted by the aid of the subjective method bequeathed by anthropomorphism, cannot be regarded as the peculiar possession of any particular stage.

But while Comte's theorem, in spite of these

radical defects, contains a germ of truth and has been found to be eminently useful as a formula for intellectual development, I cannot but be surprised that Comte should have regarded it as the fundamental law of social progress, and still more that such able writers as Mr. Mill and Mr. Lewes should at the present day be found countenancing such an opinion. Does this "law" explain how it was that Greek civilization prematurely failed? Does it throw any light upon the causal connection between Roman universal dominion and the Christian sentiment of the brotherhood of men? Does it recognize the distinction between the growth of a community in size and its growth in structure, or hint to us that the differences between Chinese and European civilization may be summed up in the statement that China is only a stupendous tribal community, while Romanized Europe is virtually a federation of exceedingly heterogeneous national aggregates? And while, as we shall presently see, it unconsciously recognizes that intellectual development is a continuous process of adaptation, does it say anything about that slow process of emotional change by which the more harmonious coöperation of societies and the more perfect freedom of individuals are alike rendered possible? Indeed it says nothing about any of these things; and I must think that these are very extensive

lacunæ in a theorem which professes to be the fundamental law of social progress.

But this formula, as it stands, is not the whole of Comte's fundamental law of history. With the advance from theological, through metaphysical, to positive conceptions of the world, Comte couples an advance from military to industrial life, through an ill-defined intermediate stage — inserted, doubtless, to complete the threefold parallelism — which he calls the "legal" stage. Thoroughly to explain what he means by this "legal" stage of society would require more detail than I can here well indulge in. We must be content with observing that he means to designate that epoch, which indeed we have not yet left behind us, in which parliamentary legislation is thought competent to renovate society artificially, — in which it is supposed that legislatures can make men rich by giving them paper money, intellectual by patronizing literature, temperate by closing dram-shops. As this phase of opinion was very conspicuous in the eighteenth century, coupled with metaphysical systems of political ethics deduced from revolutionary theories of the "inherent rights of man," Comte links this whole set of doctrines together, and makes a so-called metaphysico-legal stage in social progress. But I cannot think this a happy generalization. This "legal" stage is, at the best, a phase of intellectual de-

velopment, and to introduce it into the midst of a purely social progress from military to industrial life, seems too much like committing the logical fallacy known as cross-division. Omitting this stage, then, and reducing Comte's double formula to its lowest terms, — the only ones, I think, upon which he himself would invariably have insisted, — we have the following, as the Comtean law of progress: —

The progress of society is a gradual change from anthropomorphic to positive conceptions of the world, and from military to industrial modes of life; and the latter kind of change is determined by the former.

Such is the form of statement most favourable for Comte, and at the same time I believe it to be the one which best represents his permanent opinion. We shall presently see that the generalization of the change from military to industrial modes of life is one of great value, and it is to the thorough elaboration of it that much of the merit of Comte's social philosophy is due. But I must first call attention to the fatal defect in the above formula, the defect which destroys its claim to be regarded as the law of progress. That fatal defect is its total omission of moral feeling as a factor in social evolution. Though he is far from committing Mr. Buckle's absurdity of denying that there has been any improvement in moral feeling,

Comte nevertheless falls into substantially the same error with Mr. Buckle, in attempting to explain all social progress as due simply to a progressive alteration of opinion. The error is one which seems to be shared by two other eminent writers, — Mr. Mill and Mr. Lewes. Here are the statements of the four: Mr. Mill says, "We are justified in concluding that the order of human progression in all respects will mainly depend on the order of progression in the intellectual convictions of mankind." [1] Mr. Lewes says, somewhat more vaguely, "The evolutions of Humanity correspond with the evolutions of Thought." [2] Mr. Buckle says, "The progress of mankind depends on the success with which the laws of phenomena are investigated, and on the extent to which a knowledge of those laws is diffused." [3] Comte says, "It is not to the readers of this work that I think it necessary to prove that ideas govern the world, and that the social mechanism reposes ultimately upon opinions." [4]

Now it is not so much because of what these propositions assert as because of what they omit, that they must be pronounced unsatisfactory and misleading. It is beyond question that

[1] *System of Logic*, 4th edition, vol. ii. p. 517.
[2] *Philosophy of the Sciences*, p. 23.
[3] *History of Civilization*, vol. ii. p. 1.
[4] *Philosophie Positive*, tom. i. p. 48.

the progress of mankind does depend upon the progressive conformity of the order of their conceptions to the order of phenomena; but, after the inquiry contained in the preceding chapter, I believe no further proof is necessary to convince us that the progress of mankind also depends upon the progressive conformity of their desires to the requirements arising from their aggregation in communities. If civilization is a process of intellectual adaptation, it is also a process of moral adaptation; and the latter I believe to be the more fundamental of the two. The case is well stated by Mr. Spencer, in the following passage: "Ideas do not govern the world; the world is governed by feelings, to which ideas serve only as guides. The social mechanism does not rest finally upon opinions; but almost wholly upon character. . . . All social phenomena are produced by the totality of human emotions and beliefs: of which the emotions are mainly predetermined, while the beliefs are mainly post-determined. Men's desires are chiefly inherited; but their beliefs are chiefly acquired, and depend on surrounding conditions; and the most important surrounding conditions depend on the social state which the prevalent desires have produced. The social state at any time existing is the resultant of all the ambitions, self-interests, fears, reverences, indignations, sympathies, etc., of ancestral citi-

zens and existing citizens. The ideas current in this social state must on the average be congruous with the feelings of citizens; and therefore, on the average, with the social state these feelings have produced. Ideas wholly foreign to this social state cannot be evolved, and, if introduced from without, cannot get accepted — or, if accepted, die out when the temporary phase of feeling which caused their acceptance ends." This statement, I may observe in passing, is well illustrated by the abortive attempts of missionaries to civilize the lower races of mankind by converting them to Christianity. Though they sometimes succeed in procuring temporary verbal acceptance for Christian ideas, they almost always fail in effecting a genesis of Christian feeling, and such civilization as they are able to produce is apt to be both superficial and transient. This is simply because civilization is not a mere process of external acquirement, but is a process of slow adaptation or breeding, which requires many generations to effect a permanent modification of character. The Fiji, whose language contains no words expressive of the higher emotions or the more exalted principles of action, cannot be made into a Christian. You may cover him with a very little of the external varnish of civilization; you may astonish him into accepting a few formulas, to him quite unintelligible, concerning

the relations of man to his Creator; but after all he remains a savage still, in feelings and in habits of thought, bloodthirsty, treacherous, and superstitious, with a keen appetite for human flesh. Or suppose you could resuscitate a mediæval baron — one of those innumerable freebooters who lived entrenched in the romantic castles of the Rhine and levied blackmail on every luckless wayfarer — suppose you could resuscitate such a man, and were to endeavour to expound to him in the simplest language a few of the most self-evident modern axioms concerning political rights and the interdependence of human interests: would he understand you? By no means. So vast would be the difference in mental habit, that in all probability he could not even argue with you. "Hence" — to continue with Mr. Spencer — "though advanced ideas when once established act upon society and aid its further advance; yet the establishment of such ideas depends on the fitness of the society for receiving them. Practically, the popular character and the social state determine what ideas shall be current; instead of the current ideas determining the social state and the character. The modification of men's moral natures, caused by the continuous discipline of social life, is therefore the chief proximate cause of social progress."

It is worthy of note that Comte, in his later

period, comes partly around to this very point of view. At the beginning of the "Politique Positive," we find him announcing that the increasing tendency in the altruistic impulses to prevail over the egoistic impulses is the best measure by which to judge of the progress of society.[1] Yet the unsteadiness with which he grasped this principle is revealed by the somewhat misty statement, a few pages further on, that "the coördination of human nature as a whole depends ultimately upon the coördination of intellectual conceptions." A similar fluctuation in opinion may be noticed in Mr. Buckle; and it was indeed hardly possible for the function of moral feeling as a factor of progress to be thoroughly understood by writers unacquainted with the laws of adaptation upon which the scientific interpretation of that function is based. But whatever Comte's latest opinions may have been, since he never formulated any law to include the action of moral feeling as a factor of progress, his claims to be regarded as the founder of sociology must rest entirely upon his theory of progress as announced and elaborately illustrated in the "Philosophie Positive."

That theory, as we now see, is much too incomplete to serve as the foundation for a scientific study of history. Civilization cannot be summed up in the correct formula that men's

[1] *Politique Positive*, tom. i. p. 16.

occupations begin by being military and end by being industrial, or in the incorrect formula that men's conceptions of the world begin by being anthropomorphic and end by being positive; nor is it true that the former change is determined by the latter. We need to add the formula that men's feelings begin by being almost purely egoistic and must end by being altruistic to a considerably greater extent than will suffice to prevent individual interests from clashing. And even with all three formulas before us, we need something more before we can say that we have obtained the Law of Progress. These formulas are historical generalizations of great value; but as thus announced, they are too isolated with respect to each other. The progress of society is not moral progress, or intellectual progress, or material progress; but it is the combination of all the three. Our three formulas, therefore, must be integrated in a single formula. And this is done, and satisfactorily done, when it is shown that they are all involved in that law of adaptation or adjustment which underlies sociology, as well as psychology and biology.

That the progress from egoism to altruism is involved in that fundamental law was proved in the preceding chapter, and has been illustrated throughout the whole of this discussion. But the law of adaptation equally involves the pro-

gress from Anthropomorphism, not to Positivism, but to Cosmism, as a necessary corollary. For what does that progress depend upon? What is the underlying process of which it is the necessary symptom and result? Why is it that men begin by investing the unknown causes of phenomena with quasi-human attributes and end by recognizing a single Cause which is inscrutable? In treating of deanthropomorphization (Part I., chapter vii.) we examined this point. We perceived the primitive anthropomorphism to be a corollary from the relativity of all knowledge. We saw that, to interpret phenomena at all, men must interpret them in terms of their own consciousness. We saw that before the dawn of science, when events seemed isolated and capricious, the phenomenon itself was by a natural inference — which only the progress of science has taught us to correct — endowed with a quasi-human personality. We traced the manner in which, as phenomena become generalized in wider and wider groups, the causes of phenomena become conceived as more and more abstract, and become stripped by slow degrees of their anthropomorphic vestments. Until finally, when generalization has proceeded to such an extent as to give us a single grand science of Cosmology, dealing with the Universe as an integral whole, there comes to be recognized a single Cause of phenomena, which, as being in-

finite, cannot be in any anthropomorphic sense personal, and which, as being absolute, must be inscrutable.

Thus we see that Comte's formula is not fundamental, even as a formula for intellectual development. The process of deanthropomorphization is not the fundamental fact. The continuous organization of knowledge and generalization of phenomena is the fundamental fact, of which the continuous deanthropomorphization is the necessary symptom and result. Now in Part I., chapter ii., we traced the outlines of this continuous organization of knowledge; and we found that the advance from incomplete to complete knowledge consists in the continuous establishment of groups of notions which are ever more coherent within themselves, while they are ever more clearly demarcated from one another. Now what is all this but a continuous process of differentiation and integration? When we say that from first to last, from the simplest cognitions of infancy to the widest generalizations of science, we cognize phenomena invariably through difference and likeness, we mean that we are continually differentiating notions answering to unlike phenomena and continually integrating notions answering to like phenomena. Or, to express the same thing in other words, we are continually establishing relations of likeness and unlikeness among our concep-

tions, that in some way or other definitely correspond to relations of likeness and unlikeness among phenomena. Thus our intellectual progress is at bottom a process of adaptation. And when treating of the Test of Truth (Part I., chapter iii.), it was shown that Truth, the goal of intellectual progress, is nothing else than the complete adaptation of the order of conceptions to the order of phenomena, — the establishment of inner relations that are in equilibrium with outer relations. Thus we obtain a veritable law of intellectual progress — whereas to say that men's conceptions pass from Anthropomorphism to Positivism is merely to enunciate an empirical generalization, which, besides being empirical, is also radically imperfect.

The gradual change from a military to an industrial life must also seek its rational explanation in the law of progress as above formulated. The diminution of warfare and the concomitant increase of devotion to industrial pursuits are entailed by the growth of communities in size and structure. Among the primitive tribal societies there is no industrial life save that implied in hunting and fishing, and at a somewhat later date in the rearing of domestic animals. Settled agricultural pursuits require a greater power of continuous application and a more developed ability to subordinate present enjoyment to the anticipation of future needs than is to be

found in the primitive savage. It is only the mental habit produced by long-continued social discipline which enables us to work to-day that we may enjoy the fruits of our labour at a distant period. The primeval tribe wanders from spot to spot, seeking ever a better hunting-ground or richer pasturage, leading a predatory life which differs in little save in its family organization from that led by the lower animals. In this stage of society constant warfare is inevitable, since each tribe must fight or be crushed out of existence by neighbouring tribes. Over a large part of the earth's surface, such has been the monotonous career of savage man from the earliest times until the present day. Such appears to have been, in its main features, the ancient history of our own country before its conquest by Europeans, as it is admirably delineated in the writings of that acute observer Mr. Parkman.

The exigencies of warfare, however, of themselves facilitate that integration of tribal communities which we have seen to be the indispensable condition of progress. A considerable step toward civilization is taken when tribes begin to aggregate for mutual defence over a wide tract of country. When America was discovered, an aggregation of this sort had apparently begun to be formed among the Iroquois; and such was the highest organization reached by

the ancient Turanian tribes of Central Asia. A far more important step is taken when warfare ceases to be purely destructive and becomes acquisitive; or, in other words, when the victors, instead of massacring the vanquished, begin to make slaves of them. By this step agricultural industry is fairly brought into existence, and the tribal confederacy becomes fixed in location and enabled to increase indefinitely in size at the expense of the less highly organized communities in the neighbourhood. Under these conditions the tribal confederacy may grow until it takes on the semblance of an "aggregate of the third order," as in China,[1] or in ancient Egypt, Assyria, Media, Lydia, and Persia. I am expressing something more than an analogy — I am describing a real homology as far as concerns the process of development — when I say that these communities simulated

1 "In every respect the Chinese constitution of society may be regarded as a gigantic amplification of the constitution of the family. The family is no doubt the constituent element of which all societies are composed; just as, in the body, all tissues, nervous or muscular, are generated from the primitive cellular tissue; but whereas in other societies we find differentiation into classes and institutions which have no direct analogue in the family, in China we find far less of this, far more of adherence to the primitive social tissue, to the patriarchal type. On this type the village and the empire are alike moulded." Bridges, in *Essays on International Polity*, p. 401.

modern European nations much in the same way that a tree-fern of the carboniferous period simulated the exogenous trees of the present time. The vast growth and the considerable civilization obtained by such communities were rendered possible only through the institution of industrial slavery in place of the primeval indiscriminate slaughter of captives. Only through enforced labour did the continuous culture of the soil and the consequent stability of society become possible; a point which Comte clearly saw, and has brilliantly illustrated.

Thus we see how the exigencies of self-protection entailed by the primitive state of universal warfare furnished of themselves the conditions for the rise of industry. We need not trace in detail the slow growth of the industrial spirit at the expense of the military spirit in the ancient civic communities, in the ancient and mediæval Empire, and in modern times. That has been done, with a masterly hand, by Comte. We may only note briefly how industry — the offspring of slavery, itself the offspring of warfare — has all along, by aiding the differentiation and integration of society, been draining the vitality out of its primeval parent. Let us note, then, that the kind of differentiation, known as "division of labour," by rendering the various portions of the community more and more dependent on each other, renders a state of

warfare ever less easy to sustain, and therefore continually, though slowly, diminishes the frequency and shortens the continuance of wars. The statement that in early times a community is, on the whole, better able to endure protracted warfare than in later times, may be illustrated by a comparison between the Punic Wars of Rome and the War of Secession in our own country. The horrible destruction of life and property occasioned by the first and second Punic Wars is minutely described in Mommsen's "Roman History." The first of these desperate struggles lasted twenty-three years, during the five severest of which the census of Roman patricians was diminished by one sixth of the whole number, — a fact terrible to contemplate when its full significance is realized. After twenty-three years of comparative quiet began the still more deadly struggle against Hannibal, which lasted seventeen years. During this war the total loss of life in all the communities engaged — Italian, Spanish, Sicilian, and African — cannot be estimated at less than 600,000 persons actually slain; a loss which I believe somewhat exceeds that of the Northern and Southern States in the American war. But to make a fair comparison, we must include the circumstance that the population of these ancient communities was not more than one sixth as great as the population of the United States; and that in

ancient times the normal rate of increase of population was very much slower than in such a community as ours. The second Punic War was, therefore, relatively as murderous as our Civil War would have been had it continued until between three and four million lives were destroyed. And if we would appreciate the direct damage to industry which it entailed, we have a sufficient datum in the fact that during those seventeen years more than four hundred flourishing towns and villages in Italy alone were blotted out of existence.[1]

Now opinions may differ as to the possibility of our carrying on for seventeen years a war which should drain our resources as the Hannibalic war drained the resources of Italy. Probably no country could so well sustain such a trial as the United States, owing to the favourableness of our social conditions for exceedingly rapid growth in wealth and population. Nevertheless, even omitting foreign interference from the account, I do not believe the thing would be possible. I believe it perfectly safe to assert that a war like the one we have lately passed through would, if prolonged to seventeen years, entail social disintegration throughout the community. Yet the absolute military power of the United States is incomparably greater than that

[1] Mommsen, *Römische Geschichte*, tom. i. p. 671; see also p. 536.

of ancient Rome; wherein, then, lies the difference?

The explanation will be found, and the particular conclusion reinforced, when we consider the enormous increase of heterogeneity and interdependence in the modern as contrasted with the ancient community. In ancient Italy there was but little division of labour,—it required but a few simple occupations to supply the wants of the whole community. In the United States considered as a whole, the division of labour is perhaps not quite so extreme as in western Europe, owing to the sparseness of population and the purely agricultural activity of large sections of the country: still, the industrial differentiation is very great, and to supply the wants of each portion of the community a vast number of mutually dependent and highly complicated occupations is indispensably necessary. Obviously the heterogeneous community cannot so well bear the abstraction of units from its mutually dependent parts, as the homogeneous community could bear the abstraction of units from its relatively independent and self-sufficing parts. The difference is much the same as the difference between cutting off portions of a worm and cutting off portions of a vertebrate animal. You may take one of the lower worms and slice away at it for some time without destroying it, but in the case of

the vertebrate a comparatively small loss of parts entails destruction. In society the principle is the same. The Romans could lose army after army, while the few who remained at home could carry on all the agricultural and commercial operations necessary to the maintenance of the community. There were no great organized industries, manufacturing or commercial, so linked together that the destruction of any one might cause general financial disaster. But in any large modern community industry has become so heterogeneous that it is difficult for one part to take on the functions of another part, and so completely integrated that a sudden and considerable withdrawal of men from the ordinary pursuits of life can hardly take place without causing widespread suffering. And the contrast is made still greater by the industrial federation of modern communities as compared with the industrial isolation of ancient states. Though the time has perhaps never been, since Mediterranean civilization began, when a war could continue very long in one community without tending to set up disturbance in some other, yet this interaction of different states was far less conspicuous in ancient than it is in modern times. The Hannibalic war might go on for seventeen years, and Athens or Alexandria not be much the worse off for it. But before the war of secession

had continued twelve months, the consequent suffering in Lancashire was manifesting itself in riots, and England for a time seemed willing at all hazards to interfere and check the contest.

This single example — out of hundreds that might be taken — must suffice to illustrate the way in which the ever-increasing interdependence of human interests, itself both the cause and the effect of industrial progress, is ever making warfare less and less endurable. To this it must be added that both moral and intellectual factors contribute to bring about the general result. As human interests in various parts of the world become more and more inextricably wrought together, and as communities which lie apart from each other come ever into closer contact, the ancient antagonisms of sentiment between them slowly disappear, and international friendship grows at the expense of the old hostility or distrust. Thus the moral adaptation due to long-continued social discipline diminishes the warlike feelings and strengthens the feelings which maintain an industrial régime; while on the other hand, intellectual adaptation, ever adding new complication to industry, arrays the opinion of society more and more decidedly against war, as against an intolerable source of disturbance. Besides which, the very heterogeneity of the military art, the increasing complication both of the implements

and of the methods of warfare, due to scientific and industrial progress, renders war ever more costly, and makes the community less willing to engage in it. And these coöperating processes must go on until — probably at no very distant period — warfare shall have become extinct in all the civilized portions of the globe.

In so far as the present chapter has dealt with the claims of Comte to be regarded as the founder of Sociology, I believe it is sufficiently proved that these claims cannot be sustained, though in many ways he did more than any one else to prepare the way for such an achievement. If a man can ever be properly said to create or found a science, it is only when he discovers some fundamental principle which underlies the phenomena with which the science has to deal, and which thus serves to organize into a coherent ratiocinative body of knowledge that which has hitherto been an incoherent empirical body of knowledge. It was in this way that Newton may be said to have created a science of celestial dynamics, and that Bichat is sometimes, and more loosely, said to have been the founder of modern biology. In no such sense can Comte be said to have created sociology. Standing on the vantage ground of contemporary science, which enables us to discern in outline the law of progress, we can see not only that Comte was far from detecting that law, but

that, with the limited appliances at his command, he could not have been expected to discover it. Nevertheless his contributions to sociology were exceedingly brilliant and valuable, and he did perhaps all that the greatest thinker could have done forty years ago. He arrived at a double generalization of the phenomena of intellectual and material progress, as wide as could then be reached by unaided historical induction; and he verified this double generalization by an elaborate survey of ancient and modern history, which, even had he written nothing else, would alone suffice to make his name immortal. It entitles him, I think, to be ranked first among those sociologists who have proceeded solely on the historical method, — on a somewhat higher plane, perhaps, than Vico or Montesquieu, Turgot or Condorcet. That generalization, in both its branches, and in so far as it is correct, we have here seen to be a corollary from the fundamental law of social evolution obtained in the preceding chapter. We have seen that the continuous adaptation, both moral and intellectual, of the community to its environment, involves, as necessary concomitants, both the progressive deanthropomorphization of men's conceptions of Cause, and the gradual change from military to industrial habits of life. And the harmony between the results thus obtained by pursuing two wholly